HEALTH AND DISEASE

THEIR DETERMINING FACTORS

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BY

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TO

THE ANONYMOUS GRADUATE OF HARVARD
WHOSE WISDOM AND GENEROSITY MADE
POSSIBLE THE DEPARTMENT OF HYGIENE
IN HIS ALMA MATER

PREFACE

The dissemination of information concerning matters of health is not only generally accepted as desirable, but such education of the public is the basis of much of the present-day work for better health. This attitude is in marked contrast to that which has existed up to the immediate present. In the Middle Ages, for example, a medical treatise was issued in the vulgar tongue, rather than in Latin, the customary language of learning, and was carefully guarded lest it fall into the hands of the laity, in order "that these pearls should not be cast before swine." But at the present time the medical profession is beginning to appreciate the value of intelligent coöperation on the part of the laity and to respond to the insistent demands of their non-professional brethren for instruction in the preservation of health and the avoidance of disease. Through the gradual education of the public to the possibilities of health improvement, within the limits of a generation the death rate has decreased from thirty-one in a thousand of population to slightly over thirteen per thousand. That this decrease may continue until in time we may approximate the possibilities suggested by the knowledge which we have, the public must be

shown not only how to improve the health of the individual but also how to improve that of the community. And the two considerations cannot be separated. No matter what state of individual efficiency in health may be obtained, it may prove entirely ineffective or worthless in the event of a breakdown in the community hygiene.

That the public appreciates the importance of an understanding of health is attested by the undoubted success of many books dealing with specific phases of the hygiene of the individual and the crowds which throng to lectures on the problems of health. Much good has been accomplished through such agencies, but the effort to be popular is attended by certain dangers. The endeavor to turn a catchy phrase may present the temptation to be sensationally emphatic at the expense of scientific accuracy, and over-positive statements may give an entirely erroneous impression of the facts. The use of such striking slogans as "Swat the fly and avoid disease" is an illustration. The elimination of flies is a fairly important health measure, but, in point of fact, the amount of disease carried by flies is probably small. Again, it is the fashion to speak of all deaths from tuberculosis as preventable. While this may be theoretically true, we cannot make it absolutely and practically so until we acquire further knowledge. Another danger of certain aspects of health publicity is the almost unavoidable difficulty of creating the impression that one phase of hygiene is all important. It is self-evident, for example, that no matter how excellent and scientific a diet may be, it will accomplish little if other phases of hygiene do not receive attention.

As a matter of fact the hygiene of food, air, and the like depend upon simple principles which can be appreciated by any one. But to achieve anything

approaching excellent hygiene these principles must be understood. The attempt to follow recipes for health, no matter how excellent, without a knowledge of the underlying principles may, and often does, result in ludicrous, if not grievous and injurious, fadism.

The present book has been prepared in the belief that a discussion of the factors which determine health and disease, in the terms of the new Preventive Medicine, would provide the information which the individual should have to meet intelligently the health problems of himself and of the community in which he is a citizen. The endeavor has been to present in non-technical language the facts to which medical science can truthfully assent without exaggeration and without undue emphasis upon any phase of any question. Further, something of the history of disease and of medicine has been presented in the belief that such a knowledge should be a part of the mental equipment of any well-informed man or woman. The book contains, then, the principles which should guide an individual in living an effective life to its allotted span; the principles which should govern a community in facing its many problems of health and which a citizen should know to act intelligently and wisely towards this vital function of government, and something of medical history and progress, as well as of the fields still to be explored. This material has been based on the assumption that the intelligent layman, who, after all, is keenly interested in health and disease in his own person and in his family, and who pays not only the doctor's bills for himself and family, but also his share of the community's medical bills in taxes, is entitled to a straightforward exposition of the underlying principles of health and disease. He desires and should be allowed to share not only in medical knowledge, but also in medical ignorance. On the other hand, it cannot be expected nor does it

seem desirable that the layman shall undertake to diagnose or to treat the individual ailment, so all detailed symptoms of diseases and the treatment of diseases have been omitted. The proper sphere of activity for the layman is coöperation in the prevention of disease, and this can be done only through an understanding of the factors which determine health and disease.

Most of the material in the following pages was first presented in a series of lectures before classes in Harvard University. Indeed, the difficulty in finding in any available form the facts to afford a basis for the formation of judgments on the specific and general problems of health led to the idea of giving in book form this summary of the knowledge that has been gained from scientific medicine.

Of necessity, from the character of this book, there has been opportunity for the inclusion of no extended amount of original material. First-hand sources of all sorts, medical books, monographs, and periodicals, have been consulted freely. The reports of the Public Health Service have proved a veritable mine of information. The reports of state boards of health, particularly those of Massachusetts, of various commissions, associations, and committees, both in this country and elsewhere, have been consulted extensively. Rosenau's "Preventive Medicine and Hygiene" and Harrington and Richardson's "Practical Hygiene" have been used, with others, for general reference. On special topics, Lusk, Atwater, Locke, and Friedenwald and Rührāh on foods; Koren on alcohol; Gorgas and Ross on insect-borne diseases; Oliver, Thompson, and others on occupational diseases; Hoffman on cancer, and Hazen on water should, perhaps, receive special mention. On the subject of sewage I have endeavored closely to follow the views of Professor George C. Whipple.

I desire to make acknowledgment of my great indebtedness to Mr. E. G. Rich for general editorial supervision and for his unflagging coöperation in gathering and arranging the material and preparing it for the press.

ROGER I. LEE

HARVARD UNIVERSITY,
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CONTENTS

HEALTH AND DISEASE

INTRODUCTION

While the laws of health and disease are as firmly fixed and as immutable as the other laws of Nature, they cannot be stated as yet in positive and definite terms. Our knowledge of these complex laws is far too incomplete for us to grasp even all of the salient points, to say nothing of many of the details. In the main, however, the underlying principles of the laws of health and disease have been disclosed and have been tested and proven by experience.

The health of the individual depends upon many factors, although all may be classified in two groups, heredity and environment. While in some instances heredity is the predominating factor, in more environment is the determining factor in the life of the individual even to the extent of modifying the influence of heredity.

The influence of environment upon the health of the individual is extremely complex, and its component factors are many and overlapping. Necessarily these factors vary in importance, although we do not yet know the relative influence of all of them. A few of these determining factors are absolute, but there are many others of less potency, which, especially when collective, contribute definitely towards making for health and disease. Certain of these factors can be controlled by the individual himself, — that is by his

personal habits, — while others can be controlled only by groups of individuals, *i.e.* the community. Still other factors cannot be controlled in the light of our present knowledge.

Theoretically all disease is preventable. Such an assumption, however, implies the complete knowledge of the causes and determining factors of disease and the application of that knowledge. This is an ideal state of affairs which is far removed from actual practice, although it is true that our knowledge concerning disease is far ahead of our application of it. In 1915 there were 909,155 deaths reported in the registration area of the United States (about two-thirds of the total population). With these figures as a basis, statisticians have estimated that there are yearly in the entire United States over 600,000 deaths which might have been prevented; that over a billion dollars is wasted annually through unnecessary illness and premature death, and that, on the average, fifteen years of life are lost through the lack of application of the available knowledge concerning health and disease.

To conserve all these lives would necessitate the ideal application of our knowledge. Such an ideal is probably impossible of attainment; nevertheless, such statements illustrate the effect of the failure to disseminate and apply the knowledge at hand. The responsibility for this unfortunate failure is to be divided among the experts, the community, and the individual. Only coöperative activities will insure the desired results. The whole conception of the prevention of disease is new. It is new because the necessary knowledge upon which the prevention of disease is based is new. Now it is necessary to reconstruct the primitive instinct for self-preservation on the firm and rational foundation of disease prevention and health preservation.

Until recent years man was almost defenseless against

disease. Here we are faced by the biological fact that man is governed by the same instinct of preservation which is so dominant in all animals. Coincident with the mental development of man came a deterioration of the special senses that go so far in protecting animals. The civilization of man introduced new problems of health and disease. The herding of individuals in cities, the specialized industries, the necessary transportation of food and drink have drawbacks in increased exposure to disease. Furthermore, man suffers from many diseases which are peculiar to his species and are not found in the lower animals. In spite of his superior intelligence man has less defense against disease than have the lower animals. Then, too, for many years his energies were devoted, almost exclusively, to the cure of disease rather than to its prevention. At times, inspired by blind fear, man fled pestilence, and this may be said to represent the origin of the prevention of disease by quarantine and isolation.

Out of ignorance there grew up superstitions and customs which in part regulated the habits and life of man. Some of these were sound, while others were definitely harmful. Many of these customs finally became securely incorporated in religious beliefs. Thus the Mosaic Law gives instructions on habits of life, instructions which are sound from the viewpoint of hygiene. But man regulated his life in accordance with his religious beliefs, his customs, or his desires.

Then came the growth of all the sciences and the birth of medical science. But, in general, people still regarded medical science as only applicable to the care and cure of the sick. Slowly, however, the true instinct of self-preservation began to assert itself. The preservation of life was, manifestly, the preservation of health. Equally obviously the preservation of health was the avoidance or the prevention of disease.

Within the past forty years medical science has made prodigious strides in solving the mysteries of health and disease. Hardly a year has passed without some discovery that has saved or prolonged life. As a result we have acquired a considerable knowledge of disease, its causation, and its prevention. While there is still much ignorance and many problems remain to be solved, it is not unreasonable to expect that the next forty years will see as great an advance in our knowledge as the past forty.

Exact medical knowledge is derived from a multitude of sources. Every science has been drawn upon to contribute its share. Chemistry has solved the mystery of the air we breathe, has analyzed our food and drink, our blood, our organs, and our excretions. Physics has given to us the microscope, the necessary implement of exact medical information, the Roentgen ray, and other products of electricity. Bacteriology has revealed many of the minute organisms which cause the communicable diseases. The engineering sciences have accomplished the purification of water and the safe disposal of sewage. And so the list could be extended. Scientific medicine has taken from all the sciences. It is impossible to ascribe to any science or to any source its exact influence in shaping medical science and preventive medicine.

Three methods of investigation through the utilization of the various sciences have made possible our present knowledge of health and disease. These methods are the dissection of the body after death, animal experimentation, and the study of vital and morbidity statistics.

Human anatomy and physiology are wonderfully contrived. The vital organs are so situated in the interior of the body, carefully protected by external structures against ordinary accidents, that the examina-

tion of the exterior gives but little clue of the wonderful mechanism within. In order to understand the internal machinery, it is necessary that it be examined with the minutest care. The very existence of the heart, to say nothing of its detailed structure, would be unknown without the dissection of the human body. The prejudice against such dissection is perhaps natural, but in no other way can a knowledge of the internal mechanism of the body be obtained. In the case of disease this examination is even more important. We diagnose positively heart disease, pneumonia, typhoid fever, tuberculosis, internal cancer, and Bright's disease because we recognize a certain train of symptoms, a certain group of manifestations by external signs which have been shown by post-mortem examinations in the past to be associated with those actual organic changes. The accuracy of the diagnosis depends solely on the previous correlation of signs and symptoms during life with the actual conditions found after death. Careful post-mortem examinations are constantly bringing new facts to light. The problem of tuberculosis, for example, can now be studied much more intelligently, since examination at autopsy has shown that most persons dying from other causes have suffered at some time in their lives from a tuberculous infection. So the extension of our skill and accuracy in diagnosis depends upon the continuation of the dissection of the human body.

The immediate application of the facts of normal and abnormal anatomy and physiology is seen in the physical examination. By careful examination the skilled physician can detect abnormality in its incipiency. Many abnormalities which are incurable in the advanced stages are curable when detected early. Then, too, it often happens that abnormalities exist of which the patient is entirely unaware. Every

disease must have its beginning and the onset of symptoms that attract the patient's attention is usually delayed until considerable progress has been made.

From any point of view it is desirable that all persons should have periodic complete physical examinations. For the individual's own welfare it is essential that abnormalities be detected and corrected or controlled if possible. For the welfare of the community it is necessary to detect and prevent the further dissemination of any communicable disease. Lastly, for the increase of knowledge of health and disease by which every one benefits, the cumulative data derived from physical examinations enable the establishment of accurate standards for normal and abnormal under all conditions of life.

The second source of information concerning health and disease is animal experimentation. This experimentation is not, as is not always realized, confined to the lower animals. Experimental fasts and diets carried out by human beings have largely solved many problems of metabolism. Man has repeatedly volunteered for experimentation, and we have a typically heroic instance in the fight against yellow fever. It should be emphasized that animal experimentation is by no means synonymous with pain and suffering. Many of our facts on heredity have been derived from simple experiments in breeding. Probably ninety-nine per cent of the experiments on the lower animals consist in inoculations, which, with the less sensitive nervous systems of such animals, produce less pain than a simple pricking of the finger by a pin. In the remaining one per cent, the experimentation is almost always carried out under the influence of anesthetics with the same surgical asepsis which characterizes operations on human beings.

Before the birth of medical science, practically every therapeutic procedure was an experiment on the patient. Now there is no disease of which we have any knowledge to which carefully controlled experiments on the lower animals have not contributed. Furthermore, in perhaps a more positive and convincing fashion, important cures and preventive measures, as diphtheria antitoxin, smallpox vaccine, and the like, depend solely on animal experimentation.

Man uses the lower animals for food, to carry burdens, or for companionship, or sport, purposes as naturally repugnant as animal experimentation. Custom and human needs have permitted all these practices under proper conditions, and it would seem self-evident that the use of animals for the saving of human life is equally justifiable.

Vital and morbidity statistics, or the bookkeeping of health and disease, are always a fund of information. While the importance of reliable vital and morbidity statistics is hardly fully appreciated, yet the imperfect records of the past have helped to solve many problems of disease. Without statistics the size and scope of a problem cannot either be understood or intelligently attacked. Every individual and every community has the right to be protected as far as the experiences of other individuals and other communities make possible.

Many old problems of health and disease remain to be solved, and new problems are arising constantly. Medical science, in its broadest sense, will continue to exact contributions from all possible sources. With the growth of communities the engineering sciences must be called upon to solve many problems of municipal sanitation. The special sciences will doubtless furnish other instruments and much special knowledge. In the last analysis, however, knowledge of man, particularly

of his health, will be derived from the study of man, from the records of man — vital and morbidity statistics — from observations of man, both in health and disease, proven by examination after death or by experimentation.

CHAPTER I

Heredity

Heredity *versus* Environment. Among the many determining factors of health and disease there is, in the case of each individual, one factor which cannot be altered. This is the factor of heredity. We cannot choose our ancestors, nor, try as they will, can our parents change certain characteristics of mind and body which they hand down to us. Sex, racial and family peculiarities, the red skin of the Indian, the black skin of the Negro, the eye of the Oriental, the Hapsburg chin are all manifestly predetermined and beyond the reach of human influence.

We come into the world with certain mental and physical characteristics which, however much environment may tend to develop or suppress, are our birthright to which or from which we cannot add or subtract. Some of the more potent of these characteristics will be evident and will play a dominant rôle in our lives, irrespective of the conditions of existence. Even the most potent, however, are probably susceptible to some modification through the influences which we characterize as environment. Not all of these characteristics will be manifested, either through lack of development or through training, under the conditions of life, of opposite acquired characteristics. Thus we can conceive of a great potential pianist who never knows a piano, or of the puny child of delicate parents, who may grow into vigorous manhood through in-

telligent care of his body, or of the person with an inheritance of placid temper which may become acrid and irritable through association in youth with persons of unbalanced nervous systems or through a multiplicity of adversities through life. But as we analyze the evidence for and against the inheritance of characteristics, we find a much smaller number which are immutable than is popularly and commonly supposed.

We know that nutrition and exercise have a profound influence on physique, and that education, training, and association have even a greater influence on the mind and character. All such post-natal influences we group together under the general term of environment. It is at once evident that as a child imitates the mode of life of the father, the child will tend to reflect the same results of the environment as the father. A child, for example, may imitate the outbursts of temper of the father and, subjected to the same exasperating environment, may become a man subject to fits of anger. This characteristic may be attributed to either heredity or environment. Likewise, the child of studious parents may, if studious, be said to have derived this characteristic from heredity or environment. But in the case of a child stolen by thieving gypsies, who grows up to be a thief, environment must be the determining factor, just as in the case of the adopted child of an intellectual couple, who turns out to be feeble-minded, heredity must be the determining factor.

Light on this most complicated relation between heredity and environment is extremely important, since, for the future of the race, it is highly desirable to know what characteristics of mind and body are transmissible by inheritance and what are dependent on environment. It is necessary to ascertain as minutely as possible what characteristics of mind and

body are not only predetermined but fixed and unalterable, and what are not; how to accentuate, by the factors of heredity and environment, the good characteristics and how to obscure the bad, and what are the results in posterity of the mixture of predetermined and acquired characteristics in all sorts of possible combinations. While it is true that we cannot modify the traits of our ancestors, yet by environment we can modify profoundly our own lives and some of our characteristics and we can attempt to modify posterity by selection of the other half of our child's inheritance.

Our sources of information on the vast subject of heredity are two. In the first place we have the immense data of human experience from which to draw. Information from this source is haphazard and unscientific, since carefully controlled experiments in human breeding are not possible. Our second source of information is through experiments on plants and animals, and through such experiments some of the fundamental factors in heredity have been disclosed. Yet, while accurate observations can be made and final conclusions drawn which are true for plants and animals, it is not possible to transfer all the details to the peculiar and the more complicated problem of heredity in the human being.

The Accumulated Data of Human Heredity. From time immemorial the classic controversy over the relative influence which heredity and environment play in determining physical and mental characteristics has continued. The believers in the supreme importance of heredity have been represented by the aristocrats, while the contenders for environment have been represented by the common people. The Socialists of to-day, for instance, believe in the predominating influence of environment, while to the aristocrat

heredity means everything. The aristocrat maintains that one can only be born a gentleman and that on birth depends a man's intellectual and social status. In his arrogance of birth he attributes to it many qualities which are definitely the product of aristocratic environment.

Our knowledge of heredity has consisted for a long time of a number of isolated facts. It has been well known that large people breed large children. The transmission of such family characteristics as light hair, blue eyes, and a general resemblance is well recognized. It is generally accepted that colored people will breed colored children, and that the mingling of colored and white people will produce a mixture of colors. Then we know that certain races are more immune or more susceptible to certain diseases than other races, while a few diseases are definitely inherited. It is known that some diseases, gout and hemophilia, for example, occur regularly in certain families. At one time the belief in heredity was carried so far that it was thought that such a disease as tuberculosis was entirely hereditary. We now know, of course, that none of the infectious diseases are hereditary, but are due to contact. This contact may occur in the womb, and we speak, rather inaccurately, of inherited syphilis.

We have learned to appreciate and to disbelieve in the transfer of gross bodily mutilations. If a man has a leg cut off, for example, there is not the slightest chance that any of his children will lack a leg. We have also learned that it is impossible to pass on by inheritance the results of any training of the mind or body.

Many people have believed in the so-called prenatal impressions, a favorite device of writers of fiction. It was supposed, and is still supposed by some, that the

mother, when carrying a child, could impress certain things on the child. This is absolutely impossible, at least to a physical extent. Hereditary influences are consummated once and for all in the union of the spermatozoon and the ovum.

The Jukes and "Kallikak" Families. We have learned a great deal about heredity through the study of families of abnormal individuals. The study of the Jukes and so-called Kallikak* families has furnished us with a large amount of data which has permitted us to draw valuable conclusions. The Jukes family was descended from a lazy and irresponsible backwoodsman. As his descendants have lived in New York state since 1720, it has been possible to study the family with considerable care. In five generations the Jukes' descendants numbered approximately 1,200 people, and the histories of over a thousand of them have been worked out. Some three hundred died in infancy. Of the remaining, 310 were paupers living in almshouses; 440 were physical wrecks due to gross irregularities of life; more than half the women were prostitutes; 130 were convicted criminals; sixty were habitual thieves, and seven were murderers. None of the Jukes ever got a common school education; only twenty ever learned a trade, and ten of these learned it when in prison, where they had no alternative.

The so-called Kallikak family is, perhaps, even more suggestive. Kallikak was descended from good English stock and served as a soldier in the War of the Revolution. He had sexual relations with a feeble-minded girl, and she bore him a son who was also feeble-minded. This son married a normal woman. They, in turn, produced five feeble-minded and two normal children. From these children have come

* Goddard, H. H., "The Kallikak Family." New York. 1912.

480 descendants. Thirty-six of these were illegitimate; thirty-three sexually immoral; twenty-four confirmed alcoholics; and three epileptics. Eighty-two died in infancy, three were criminals, and 143 were distinctly feeble-minded. Only forty-six who were apparently normal have been found.

After Kallikak had started this degenerate line, he married a normal girl of good ancestry. From this union with a normal woman there have been 496 descendants. Only two of this number showed anything but a normal mentality. Both exceptions were insane, probably due to marriage with an outside stock of insane tendency. Not a case of feeble-mindedness appeared among the 496; on the contrary, all occupied positions in the upper walks of life, and there were no criminals among them.

From this evidence it becomes obvious that feeble-mindedness is not a question of environment, but largely, if not entirely, a matter of heredity. The law of heredity is that feeble-minded, who marry, will have feeble-minded children. Every child of two feeble-minded parents will be feeble-minded.

Feeble-mindedness. Feeble-mindedness is of varying degree. In the lowest scale is the idiot; next comes the imbecile, and then the high grade mental defective, who is classified under the term, moron. The degree of mental development which constitutes feeble-mindedness has been arbitrarily fixed, for an adult, as that of a child of twelve. By the use of tests based on the principles first advocated by Binet and often called the Binet-Simon scale of intelligence, it is reasonably simple to approximate the mental development of the feeble-minded person in terms of years up to twelve. These tests merely consist of simple questions and exercises appropriate for a child of a given age. The idiot is able to do the tests up to the level of the

normal child of two; the imbecile the tests for a child between two and seven years, and the moron those of a child between seven and twelve. It is now believed that such tests are not applicable to mentalities corresponding to children over twelve. While it is thus impossible to designate by examination as feeble-minded persons of manifest low mentality (that is above twelve years of age), such persons, called normal, are frequent in feeble-minded families, and are often a menace to the community.

It should be borne in mind that feeble-mindedness is entirely a mental characteristic, for the body of the feeble-minded person is normal and often unusually well developed. But despite the bodies and physical ability of men and women, the feeble-minded are children, — they have the minds of children and are controlled by the emotions of children. The anger of a child is impotent of physical harm through the lack of physical strength; not so the anger of the feeble-minded with the powerful adult frame. Hence we read of murders for trivial causes, which are inexplicable to the adult mind and often to the laws of justice. No less inexplicable is the absence of any attempt at concealment and the absence of remorse. The culprit, adult in body, views the affair with the mental vision of perhaps eight years. Stupid petty burglary and arson are the crimes to which the feeble-minded are prone, but the criminal bent of the feeble-minded is determined entirely by environment.

Among the feeble-minded we see, perhaps, best illustrated the dual influences of heredity and environment. The childlike mind, free from evil influences and associations, may go through life and, possibly, only be regarded as somewhat simple. Complicated tasks and persistent endeavor, especially in the face of obstacles, are beyond the individual, but simple

physical work, under supervision, is easy. But the chances favor childlike rebellion against the restraint of the laws and customs of society. So the fully developed physical instinct of sex plays an important rôle in the delinquencies of the feeble-minded. The sexual desires are not restrained, and the sexual immoralities of the feeble-minded are notorious. Feeble-minded women often have physical attraction and statistics show that they comprise between seventy-five and eighty per cent of the public prostitutes. So, too, the feeble-minded are frequently alcoholics and other drug habitués. In general they are industrial misfits, the ne'er-do-wells, the habitual loafers and "bums" of the community. They fill the almshouses as well as the jails, and even the insane asylums.

The high grade feeble-minded person, the moron, or the person just above that type, is a particular problem of the community. He transmits his defect and, as a potential criminal, is a constant menace to society. The trait of feeble-mindedness may be obscured by mating with a normal person, since normality is predominant over feeble-mindedness, but the trait still persists. Experience has shown that such persons cannot be allowed to roam at large. Sterilization, which has been suggested as a remedy for the problem, merely prevents propagation, but not crime. Communities are slowly beginning to realize that it is almost inevitable that such persons, depending on how their tendencies are developed by the peculiar environment, must eventually be supported in almshouses, hospitals, asylums, and jails. So it is probably wiser and more economical for the community, as has already been accomplished successfully in certain places, to support the feeble-minded in segregated colonies.

Other Hereditary Defects. Feeble-mindedness, as a purely hereditary characteristic, is the most im-

portant hereditary disease we know. While brain injury and brain disease may cause a deficient mentality, such a defect is not transmitted. Heredity plays an important rôle in the causation of other mental abnormalities, but in none, according to our present knowledge, is it the sole determining factor as is the case in feeble-mindedness. Nervous and mental instability of many varieties definitely run in certain families. Heredity, as well, is the most important factor in determining certain types of insanity.

Certain more obvious physical phenomena and conditions, such as short fingers, deaf-mutism, hemophilia, albinism, forms of chorea and ataxia, cleft palate, myopia, and the like, are peculiarly present in families and are handed on from generation to generation. We have, furthermore, the most interesting observation that hemophilia is transmitted only through females and only to males. Color-blindness is essentially a male inherited characteristic.

But it should not be supposed that only the bad traits are transmitted through inheritance. Fortunately for us the studies of families indicate as positively that the good traits are handed on with the same certainty as all the weaknesses. Marked musical talent, generosity, artistic bent, and similar qualities are essentially hereditary, as well as desirable physical attributes. A few notable families in which many of the descendants accomplished marked achievements show positively how even intellectual power is inherited. The family of Bach is an illustration of the inheritance of musical talent. This family produced twenty eminent composers and twice as many who possessed marked ability. The classical example of the inheritance of intellectual power is the family of Jonathan Edwards. The achievements of the 1394 descendants of this eminent philosopher have been tabulated by Kellicott

in his book on "Social Direction of Human Evolution." The list includes "295 who were college graduates; 13 presidents of our greatest colleges; 65 professors in colleges, besides many principals of other important educational institutions; 60 physicians, many of them eminent; 100 and more clergymen, missionaries, or theological professors; 75 were officers in the army and navy; 60 prominent authors and writers, by whom 135 books of merit were written and published and 18 important periodicals edited; 33 American states and several foreign countries, and 92 American cities and many foreign cities have profited by the beneficent influences of their eminent activity; 100 and more were lawyers, of whom one was our most eminent professor of law; 30 were judges; 80 held public office, of whom one was vice-president of the United States; 3 were United States senators; several were governors, members of Congress, framers of state constitutions, mayors of cities, and ministers of foreign courts; one was president of the Pacific Mail Company; 15 railroads, many banks, insurance companies, and large industrial enterprises have been indebted to their management. . . . It is not known that any one of them was ever convicted of crime."

Experimental Data. Approximately all the fundamental facts we know about heredity are contained in the so-called Mendel's law. Mendel was an Austrian monk who conducted extended experiments on peas. In 1866, he was able to state with definiteness some of the considerations which govern the transmission of characteristics. His conclusions, however, important as they were, did not receive the consideration which they merited until the publication of the work of DeVries, an investigator in Holland, in 1899. The essential factors in heredity, as stated by Mendel, are unit characteristics, dominance, and segregation.

A unit characteristic is one that is transmitted from parent to offspring through successive generations. When parents with complementary unit characteristics mate, it is found that one characteristic predominates in the offspring. This is dominance. Thus when Mendel crossed giant and dwarf peas, the giant peas predominated in the offspring, since the characteristic of giantism, in this illustration, is dominant and dwarfism is recessive. These unit characteristics from the separate parents usually remain separate and distinct, — segregation. We do not know just what is transmitted from parent to offspring, but it is only something which determines the development of the unit characteristic, — the determiner.

A good illustration of the Mendelian law is the inheritance of color in the Andalusian fowl as worked out by Bateson. There are two established varieties of this fowl, — one black and the other white. Each of these, by itself, breeds true to itself. Black mated with black produce black offspring; while white mated with white produce only white offspring. But if a white fowl mates with a black, the offspring will be neither white nor black, but a grayish color known as "blue." When these hybrids mate there are three colors among the offspring, blue, white, and black. Furthermore, the proportions of each color are fixed, for one-half will be blue, one-quarter black, and one-quarter white. In all generations, white from white or from blue will always breed true and so with the black. A pure race of blues cannot be established.

Guinea pigs well illustrate the law of dominant and recessive characteristics. If black and white guinea pigs are mated, the offspring will all be black. The black is the dominant characteristic and the white the recessive. These black guinea pigs are as true hybrids as the blue Andalusian fowl. If these hybrid guinea

pigs are mated, all the offspring will not be black, but three-quarters will be black and one-quarter white. Some of the blacks will breed true, while others, apparently like their black brothers and sisters, nevertheless contain the white taint, and so will breed one-quarter white.

The same principles of heredity hold true for human beings, although it is difficult to work this out, as we can rarely get sufficient details concerning our ancestors. But we do see striking illustrations of Mendel's law in the transmission of disease. The difficulty in applying the law is to determine dominance. We know, however, that normality is dominant over feeble-mindedness and insanity, and that Huntington's chorea is dominant over normality, and black eyes over blue eyes.

A further complication presents itself in the fact that all characteristics are not unit characteristics. In other words, instead of maintaining the two original characteristics and one hybrid type, we get blending, as seen in the varying shades of color of the skin in the mixed negroes and whites. As we have seen, heredity simply governs the proportions of the ultimate descendants. So the studies of human heredity are complicated by a small number of children. While the chance for the appearance of a certain characteristic is fixed numerically, we may not be able to fix the status of the individual child until we have had an opportunity to study the progeny. We may see, therefore, in the single child the outcome of at least three possibilities, and this outcome may be happy or tragic in his person, or in his progeny.

Inbreeding. Inbreeding, or the mating of people with the same characteristics, is a hazardous experiment. This is illustrated by the problem of the marriage of cousins. The objection to such marriages

rests entirely on this question of heredity. Any defect in the inheritance, such as a strain of insanity, will become intensified in the offspring by such a marriage. The intermarriage does not create the defects, but simply brings them to the light. Cross-breeding does not remove defects of inheritance; it only hides them. If an insane person is married to a person, apparently normal, but with a taint of insanity in the family, the probabilities are that some of the children will be insane. If, however, the person with a strain of insanity marries into a rugged stock, the defect will tend to be obscured, although there is a chance that the insanity may crop out again in a later generation.

The study of the results of inbreeding in many localities shows exactly what we should expect. Consanguinity on Martha's Vineyard shows eleven per cent deaf mutes; on Point Judith thirteen per cent idiots and seven per cent insane; in the Bahamas the result is idiocy and blindness; in a community on Chesapeake Bay dwarfness in stature, and on a Maine island stupidity.

The possibility of the inheritance of acquired characteristics, which are, of course, due to environment, is denied by present-day scientists, although the belief in such inheritance has existed from the earliest times. If any acquired characteristics are ever passed on, it is done very, very slowly.

In regulating our lives we should appreciate that heredity is a fundamental factor in our physical and mental makeup. The transmission of defects, excellences, and tendencies is fully recognized. Training and good habits can go far towards developing desirable traits and suppressing those that are undesirable. We should, therefore, so adjust our mode of living as to make the most effective use of our bodily and mental equipment. While as yet the knowledge of the com-

plexities of human heredity is not sufficiently complete or positive to justify marriage on the sole basis of genetics, nevertheless the data at hand may well be an influencing factor for those who desire to hand down to the next generation a good inheritance of mind and body.

CHAPTER II

Food

Nutrition. Our scientific knowledge of the subject of nutrition has been gained only within recent years. We have had, of course, a vast amount of empirical information on the subject, the result of the experience of the homekeepers of the ages. Such information, as is always the case with facts discovered in this way, has been combined with superstitions and old wives' tales, as, for instance, that a fish diet was conducive to brain development, or the equally widespread belief that fish was the cause of leprosy. The whys and wherefores of the vital function of nutrition have been learned only very recently indeed.

In the scientific studies which have been made on this subject it has been found, however, that the facts based on empiricism, as exemplified by the everyday table, correspond reasonably closely to the facts based on science. And, furthermore, while different peoples and races apparently vary widely in their diets, scientific analysis shows an actual striking similarity. Just as cattle will range far for salt, and every animal feels the need of water, so the natural instinct tends to control not only the amount of nourishment in the food, but also the appropriate balance.

Nutrition is life, for on it depends the existence as well as the growth of the body. From food we derive the necessary energy for the physical and mental work which the body has to do, and, likewise, from food are

elaborated, in some mysterious fashion, those substances which give the body the ability to resist and overcome disease. Through proper nutrition only can we reach the maximum of physical and mental efficiency, avoid disease, and maintain what we know as health.

Nutrition is accomplished by the use of foods which are taken into the body through the mouth and which, through the processes of digestion, are transformed into tissue-building material and into heat, or into its equivalent, energy. In general we consider as food only such substances as can be oxidized in the body. However, water and air are also absolutely necessary for the process of nutrition.

Processes of Nutrition. The physiology and the chemistry of the changes through which whatever we put into our mouths as food passes in order to be made into appropriate new tissue as growth or repair or into energy of mind or body is complicated and wonderful. Science has not yet succeeded in solving all the intricacies of these mysterious processes. Many of them can be repeated in the test tube, but no artificial creation can compare with the methods of Nature in handling food. Despite the endeavors of science and trade the human race is practically entirely dependent on the natural physiology and chemistry of digestion. Neither tissue nor energy can be manufactured outside of the body, so that our predigested foods are in fact a fiction. The crowning achievement of scientific feeding is to replace lost blood by new blood, not manufactured artificially, but from another person.

Furthermore, there has been little success attained in feeding in any other way than through the mouth. It is true that water can be absorbed when administered by rectum (the discharging end of the intestinal canal), also under the skin, and into the veins. Certain food substances, in limited amounts, can be absorbed in these

three ways. Unfortunately, however, the total amount of nourishment, excluding water, which can be administered and oxidized in any other way than through the mouth, is so small as to be negligible as a method of sustaining life for any considerable period of time. In other words, we do not possess the key to Nature's secret of preparing food for actual use and now, after years of research, we are still entirely dependent upon taking through the mouth food, only modified by the details of custom, taste, and health, from the natural supply. The day of the concentrated tabloid of energy is still far distant.

Food Analysis. In contrast to our lack of progress in discovering the key to the processes of nutrition, we have made enormous strides in the study of foods so far as their analysis goes. We now know that much which we eat has no food value, *i.e.* cannot be converted into tissue or heat. We can also determine how apparently similar foods differ in furnishing different elements to the body. In general we refer to a food as having so much food value. This, however, does not take into consideration either the water or certain other factors, but represents the intrinsic value of a given food in the production of tissue or heat. The determination of such food values depends upon the fact that our food has to be oxidized, — that is burnt, much in the same way that wood and gas are burnt. For this process oxygen is absolutely essential. By means of a specially designed chamber, called a calorimeter, where individuals can live for purposes of experiment, it is possible to measure accurately, in terms of heat, the food taken, as we would measure the heat of a substance directly burnt.

Through the work of various scientists we are now able to speak pretty definitely not only of the amounts of foods which the body must have, but also of the

kinds of food required. We know the precise constituents of the different foods and the particular use and value of a given food. It is fairly well determined that, in general, there are two classes of foods, — one of which builds up tissues and the other of which serves as fuel. The fuel is utilized in two ways — as energy and heat. Approximately one-tenth of our food goes to build up or replace tissue, while nine-tenths is used as fuel. Even in quiet sleep the heart beats, breathing continues, the involuntary movements and the chemical processes of digestion are taking place, and these processes must be activated by fuel. In addition, the body must be kept warm. So it is estimated that only twenty per cent of the food is used up in what we know as voluntary bodily activity.

Foodstuffs. In the study of food we find five groups of foodstuffs, — water, mineral matter or ash, proteins, carbohydrates, and fats. The first two, water and mineral matter, while absolutely necessary to life, are not oxidized, and so form no part of the heat-producing elements.

Water. Water is the most important constituent of diet, as without it a person can live for only a short time, — about five days. On the other hand, experimental fasts have lasted for thirty days, but in such fasts water was taken. The importance of water to life is better understood when we consider that the body is composed of from sixty to seventy per cent of water and that the amount which it throws off as waste has to be replaced through the processes of nutrition. Under conditions of profuse sweating the body is drained of water and this must be replenished. The same holds true in cases of profuse diarrhea. Perhaps the best guide to the amount of water which is necessary for our well-being is found in the daily amount of urine. This should be 1,500 cc. or three pints and represents the

residue after water has been extracted for all other functions. The average person, therefore, should consume from two to four liters or quarts of water a day. But this supply need not be taken as water. All foods contain some water, and the ordinary individual gets considerable quantities in such things as fruits and vegetables, not to mention the obvious liquids, — milk, tea, coffee, and soup. The habits of rabbits throw a light on the relation of vegetables of high water content to the amount of water required by the system. Rabbits which live on carrots and greens, both of which contain a large proportion of water, are never seen to drink water. They get sufficient in their food. If rabbits are fed on oats, they drink water in considerable quantities.

The amount of water taken into the system has a marked effect in regulating the proper functioning of the kidneys and digestive processes. An insufficient water intake is frequently an important aggravating cause of constipation. Many people, especially women, deliberately form the habit of greatly diminished fluid intake in order to eliminate the possible embarrassment of being compelled to respond to the periodic demands of Nature which arise when sufficient water is taken. Such a practice is closely associated with insufficient flushing of the entire system. If such a condition arises, certain deleterious substances may be left in the body, or may be eliminated with difficulty or in such a concentrated form as to injure tissues, particularly those of the excretory organs, — the kidneys.

Again, the chemical processes of digestion require a fluid medium for action. It is obvious that beefsteak or dry bread cannot go through the intestinal wall as dry powder and so absorbed by the blood. Absorption takes place much more readily if there is a reasonable amount of fluid present. There has always been a

superstition that water or fluid drinking with the meals was harmful to health. Experiments have shown that copious water drinking (one to two quarts) with each meal is attended by no harmful, but with some beneficial, results. Experience has shown that limiting the fluid intake often causes a reduction in weight, which merely means that the bodily processes are fed by the tissues of the body, rather than by the ingested food.

The importance of water cannot be overestimated, and every one should take fluid in abundance. Since the requirements vary, depending on such factors as perspiration and the like, it is wise roughly to regulate the intake by controlling the output at approximately three pints of urine a day. The form in which water is taken, *i.e.* in foods with a high content of water, in fluid foods, or drinks, makes no difference to the bodily economy so far as water itself is concerned. It is understandable, however, that the vehicle carrying the water may be harmful either chemically or physically. For example, water with caffein (coffee), water with alkaline salts or very hot or very cold water (ice-water) may injure the organism through the extraneous characteristics of the water. The injurious effects of excessive ice-water drinking are often erroneously attributed to the water rather than to the temperature, just as the beneficial effects of water drinking at a famous health spa are usually erroneously attributed to some mysterious constituent of the water or to the temperature of the water, or to the climate rather than to the simple fact of water drinking.

Mineral Matter. Another necessary element in nutrition is the mineral matter which contains such elements as calcium, potassium, phosphorus, sulphur, iron, and ordinary salt. These salts are necessary for the various structures of the body, but we need

give them little thought in arranging our diet, as a sufficient supply is found in most foods. Ordinary salt is the only mineral which we add to our food, and it is usually not even necessary to do this, particularly if we eat animal food. We get sufficient supplies in milk and other animal foods, but we must take it in some way, for upon its presence depends the osmotic pressure which produces many of the bodily processes.

Food Values. Only the substances which are used to build up tissue and supply heat are usually considered as our real foods. We can check up the tissue-building effect of food by weighing our bodies at intervals. But measuring the amount of heat is difficult. It is sufficient to say that it has been done "and very carefully done" by the use of calorimeters. Pettenkoffer, Voit, and others carried out a series of experiments for measuring the amount of water, air, and food taken in and the carbon dioxide passed out; examined the urine; registered every motion of the body, and analyzed the results which they obtained. Thus they found that all foods can be brought down to the basis of the large calorie which is the foundation of all the energy of food value. This calorie represents the amount of heat necessary to raise the temperature of one kilogram of water one degree Centigrade, or one pound of water four degrees Fahrenheit.

Foods are generally divided into three classes, but more correctly there should be four, — protein, carbohydrates, fat, and alcohol. Alcohol is usually omitted, but we have to admit that alcohol, at least to a certain amount, is a food, for, up to a certain point, it has a very definite caloric value.

The following table, prepared by Rubner, gives the caloric value of the four kinds of foods or foodstuffs, as they should be called:

1 gram protein	4.1 calories
1 gram fat	9.5 calories
1 gram carbohydrates	4.1 calories
1 gram alcohol	7.0 calories

From this table it will be seen that weight for weight fat is over twice as valuable as either protein or carbohydrates. The problem, however, is not merely a question of calories.

Proteins. The proteins include all nitrogenous foods whether of animal or vegetable origin, except the nitrogenous fats. As nitrogen is the basis of the muscle and tissue throughout the body, proteins are the tissue-building foodstuffs. The proteins include such substances as the lean of meat, the white of the egg, the lean part of fish, the casein and albumen of milk, wheat gluten, and parts of vegetables. It is well to remember that the vegetables which contain protein form tissue, as well as the animal products. The animals which serve as beef are exclusively herbivorous. These animals make the beef or the meat proteins from the protein of the vegetable kingdom, usually grass, hay, and grain. The human animal, not being exclusively herbivorous, cannot utilize as food the things which the beef animals do, but he can utilize the proteins of the vegetable kingdom just as the beef creatures, and can form human tissue on it. Consequently it is apparent that the vegetarian may not differ greatly from the meat eater in the foodstuffs which he consumes. The vegetarian goes back to the original supply for his protein, while the meat eater takes his protein slightly modified. But there is doubtless some qualitative difference between the meat and vegetable protein, although it cannot be expressed by a chemical formula. So it is probably advisable for us to get some part of our tissue-building material by the use of meat protein. The proteins, in addition to making tissue, may give

energy to the body when the supplies of carbohydrates and fats are insufficient, but in general the proteins are only tissue-builders. The use of proteins to furnish fuels is decidedly poor economy.

Carbohydrates. The carbohydrates include the sugars, gums, and cellulose, and form the principal constituents of all kinds of plants. Bread, cereals, sugar, and the vegetables are the staple carbohydrate foods. Although the carbohydrates are derived chiefly from the vegetable kingdom, they are also present in small quantities in meat, fish, and milk. Cellulose or vegetable fiber is the principal constituent of grasses, green vegetables, and fruits. Unlike the herbivorous animals, man is unable to utilize cellulose as food and it has no food value in human dietary tables.

Fats. The fats include both vegetable and animal fats, such as those of milk, butter, olive oil, corn oil, lard, meat fat, and certain other unimportant elements. Vegetable and animal fat have the same chemical formula and can be used interchangeably in the human body. The rather despised nut has a large food value, for it is rich in fat. Neither the fats nor the carbohydrates form real tissue, but when they are taken in excess the surplus may be stored up as adipose or fat tissue. Such tissue is hardly a body tissue, but is to be regarded as stored up fuel. Both the fats and the carbohydrates spare the protein elements the necessity of producing energy, for they are the energy-producing part of our diet and so, indirectly, serve as tissue-builders.

Animal Foods. The value of the different articles of our diet in nutrition is of importance in arranging our meals, and is a subject where recent investigations have changed many of our preconceived ideas. The animal foods naturally come first in consideration, as these products, through custom and tradition, play

so great a part in our diet. In meats we have a food which is high in protein, from fifty-one to eighty-nine per cent, a varying amount of fat, from five to forty-five per cent, and practically no carbohydrate. Contrary to general belief there is little difference between the food values of red and white meat. The difference is only in the presence of the extractives which have no positive food value. The average food value of meat runs from 1,000 to 1,200 calories per pound.

Fish are from six to twenty-five per cent protein, a variable amount of fat, and practically no carbohydrates. Shell-fish have less fat and a low food value in the way of nourishment, about 100 calories per pound. The caloric value of fish runs from 300 to 1,000 calories per pound. Salmon is of high value, while caviar is the highest of all.

Eggs have been overestimated as food, and they are not, contrary to general belief, a highly concentrated food. The white of the egg is almost pure protein and the yoke fat. Thus we have from eleven to twelve per cent of the food value of an egg in protein, and from nine to ten per cent fat. The total food value is about 720 calories to the pound.

Milk, as well, has been overestimated in the popular mind, and a glass of milk is by no means a square meal. A pound of milk has a caloric value of only 325, which makes a glass yield about 160 calories. The importance of milk as a food lies in the proportions of fats, carbohydrates, and protein. About eighty-eight per cent of milk is water, four per cent fat, 3.6 per cent protein, and 4.5 per cent carbohydrates. The child needs a food with a considerable amount of protein and thus milk serves him well as a food. The carbohydrates of milk are in the form of milk sugar, or lactose, which is similar to glucose. The essential difference between human and cow's milk lies in the proportion of the foodstuffs.

Pure milk should contain twelve per cent of solids, and, if it does not, it is due to the fact that the product has been adulterated. The favorite way of adulterating milk is by removing the fat as cream and adding water and sugar. This procedure not only reduces the food value, but also destroys the balance of the foodstuffs.

Butter, cream, cheese, and whey, all products of milk, play a considerable part in the average diet. Whey is fat-free milk. Cream has about twenty per cent of fat. Cheese has thirty per cent of fat, thirty per cent of protein, and the rest water. Thus it is obvious that cheese has a high food value, a fact which has been greatly underestimated in this country.

Vegetable Foods. Among the vegetable foods, sugars and syrups are of the highest food value as they are assimilated by the body with but little change. The fuel value of sugar is practically one hundred per cent. Thus candy and sweet desserts, which are largely sugar, have a high food value.

The cereals and grains furnish us with most of our carbohydrates and considerable protein. Sixty-five to eighty per cent of grains are carbohydrates and from six to twelve per cent proteins. It is obvious, therefore, that one can live on a diet of bread and butter, for such a diet contains all the food elements. If to these we add cheese, we get a balanced diet.

The legumes, peas and beans, are a valuable food, for the balance between the carbohydrates and the protein is good. The protein ranges from five to thirteen per cent, and the carbohydrates from thirteen to thirty per cent. In a dried form peas and beans are a moderately concentrated food and are of a high caloric value.

The tubers and roots, such as potatoes, beets, turnips, parsnips, and carrots, contain slightly over ten per cent of carbohydrates, but no protein or fat. The proportion of water content is high.

Green vegetables have a low food value, only from 100 to 175 calories per pound. Generally they are under five per cent of carbohydrates, with little or no fat or protein, and much cellulose which is not absorbed by the human metabolism. Cellulose, however, is a desirable constituent of diet, as the digestive system requires considerable bulk on which to work. For this reason an amount of green vegetables is advisable in the dietary for the sole purpose of keeping the digestive tract in good working order. These green vegetables, such as celery, cabbage, asparagus, cucumbers, cauliflower, and onions, are used in the treatment of obesity by filling the stomach with material of low food value, which cannot produce tissue.

Fruits contain cellulose, water, and sugar, although the amount of carbohydrates is small, from five to ten per cent. Sweet fruits, like cherries, plums, and sweet oranges, contain more carbohydrates. The food value of berries is very low.

Nuts are composed of from forty to fifty per cent of fat, and from six to ten per cent of protein. Thus their food value is high, and, as their cost is usually low, they make a comparatively inexpensive food.

Alcohol. Alcohol is definitely a food, because it can be burnt, but, on the other hand, only a small amount can be used in the body, about two ounces in twenty-four hours. Any excess of this acts as a poison. Alcohol goes only to produce heat, and cannot in any way produce tissue. Whatever claims may be made for alcohol as a food, the fact remains that in this regard it is nearly negligible.

Some of the alcoholic drinks, the malt liquors, for instance, contain some nourishment in the form of carbohydrates, but, in general, these drinks depend on the amount of alcohol for any food value as well as for their poisonous effects. Beer and ales contain from

two to eight per cent of alcohol; wines from two to fifteen per cent, the amount depending on the extent of the fermentation of the grapes; and the distilled liquors, whiskey, brandy, and gin, as well as the liqueurs, from forty to sixty per cent of alcohol.

Condiments. The condiments are not foods, but simply add to the flavor. Certain foods may need salt, but we probably get a sufficient supply without adding this. Pepper, mustard, vinegar, and the like have absolutely no food value. When they are combined into salad dressings, there is usually a considerable food value, as they are mixed with olive oil. The oil gives salads the only food value which they may possess.

Beverages. The beverages of the dietary include coffee, cocoa, tea, and chocolate. Of these tea and coffee are the most alike in composition. They contain no food value in themselves, but depend for their action on certain stimulating qualities. The most important element is caffeine, and the amount in the average cup of tea and coffee is about the same. On the other hand, the way in which we take coffee and tea, usually with milk or cream and sugar, makes the drink of some slight food value, for, of course, the food value of milk and sugar is high. Preparations of coffee which do not contain caffeine have come into the market extensively of late years, and the advisability of their use depends chiefly on the matter of taste. The stimulation of caffeine, in moderate amounts, is not harmful. In large amounts, as when taken in black coffee or tea, caffeine may make a person nervous and irritable, and possibly keep him awake at night. It is true that an excess of these beverages may make the user nervous and, perhaps, make him feel badly, and the disturbance induced by an excess of caffeine may be the underlying factor of disease, but such an excess of itself causes no organic disease.

Cocoa contains a certain amount of fat and an active substance, theobromin, an alkaloid closely allied with caffeine. Cocoa is usually taken with milk and sugar, so that the food value of the beverage may be considerable.

Chocolate is made from cocoa and contains a varying amount of starch and sugar, depending upon the particular brand of the product which is used. On the whole, the nutritive value of chocolate is not large. It contains the fat of cocoa and some starch, and, in some manufactured forms, considerable sugar. In the latter case it has, of course, a high caloric value.

Availability of Food. Merely because a certain food has a definite food value expressed in calories, it does not follow that the ingestion of this food means the complete utilization of all these units. An unused portion of food appears in the excreta, the amount depending to a considerable extent upon the efficiency of the individual's digestive system, as well as upon the state of digestion at that time. Thus in order to know the exact value of any product as a food it is desirable to know not only the caloric value, but also the amount which is lost in the processes of digestion. In health, on a reasonable diet of good food, little food escapes in the excreta. It is estimated that, on the average, ninety-one per cent of the actual food value in a balanced diet is utilized. This is the possible upper limit and presupposes perfect digestive processes. Ninety-two per cent of the proteins, ninety-five per cent of the fats, ninety-seven per cent of the carbohydrates, — those of animal origin being higher than those of vegetable origin, — and ninety-eight per cent of alcohol are digested and absorbed. A considerable amount of the nitrogen of the protein, after oxidation, is passed off through the urine, so that only about seventy per cent of the protein actually taken in is available for the work of the body.

While the availability of proteins can be put down as seventy per cent on an average, these figures are only true with an average balanced diet and in an average individual in health. In disease or abnormal conditions the percentage of digestion and availability may be extremely low. Then, too, with the ingestion of an excess of one food factor the body may only take what it requires, a fraction of the amount taken in. The power of assimilating an excess of the food factors varies tremendously with different individuals. An example of this is seen in the ingestion of a large amount of fat. In most persons an excess of fat passes through the intestinal tract and can be detected readily in the feces. The excess of fat has only acted somewhat as a laxative, not as a food. Thus it is not the swallowing of a certain amount of calories, but the assimilation of those calories that determines the value of a given diet to the individual. In discussing food and food values the food itself is referred to and not the available calories.

Amount of Food. The amount of food which each individual requires depends upon many factors. The average man in health, theoretically, demands forty calories of food per kilogram of weight every twenty-four hours, but in actual experience we find that some people require sixty calories and others only half of that. Then the extent of the body surface is another determining factor. Children, who have a relatively large body surface in proportion to their weight, require more calories per kilogram. Thin people, because of the relatively larger body surface, also require more food for body weight than many of greater weight. On the other hand old people require much less food than a growing child or a man at hard work. Old people, unless very fat, often get along on from twenty-six to thirty-six calories of food per kilogram of weight.

It naturally follows that a man at hard work needs more food, *i.e.* more energy, than a man who does little work. Women require only about four-fifths as much food as a man, due largely to smaller size, a high percentage of body fat, and a less strenuous existence.

Climate and season exert some influence on the amount of food taken in and used up, but the use of clothing reduces the influence of these factors. To some extent cold weather requires more heat-making materials in the dietary.

The most important factor in influencing the amount of food required is the amount of muscular work done. But physical exercise, in the usual sense, is only a small amount of the work for which the body has to supply energy. About eighty calories out of every hundred are used up by the body as heat and internal work. Sitting about, writing, reading, and the like use up a considerable amount of energy. It is generally believed that a man at moderately hard work requires about 3,000 calories per twenty-four hours, which he can get, of course, only from his food. It is also generally accepted that brain work makes no great demand upon the food supply.

The accepted standards of the amount of food required are about as follows:

Man without muscular work	2,450 calories
Man with light muscular work (sedentary) . .	2,700 calories
Man with light to moderate muscular work . .	3,050 calories
Man with moderate muscular work	3,400 calories
Man with very hard muscular work	5,500 calories

Excess and Deficit in Food Amounts. As the result of experiments it has been found that a healthy man can live and maintain his health and weight on fewer calories than are given in the tables. Such experiments need in no way confuse us. In the first place,

everyone has his individual variations, and in the second we must consider the adaptability of Nature. Nature accommodates herself easily in health, and it is remarkable on how little food we can exist. Yet living in health on a scanty diet misses two important considerations: the margin of safety against the fluctuating demands of the body created by unusual increased activity or disease, and the habit of the individual or the race. Certain individuals and certain races habitually use less food than others. As there are other habits, so there is a food habit, and accommodating Nature makes the best of it. Once a habit is fixed, it means the confusion of the whole machinery of the body, if that habit is changed. This is as true of bad habits of eating as of good habits. The acquisition of a habit of eating a reasonable amount of food should be acquired as early as possible.

Fundamentally the human animal is like any other animal. A plump animal is synonymous with a well-fed animal but there is wide individual variation in size, even among brutes of the same litter. In the human animal the individual variation plays a large part in the question of size and the amount of food which he requires. Roughly speaking the fat man has three characteristics: he eats a large amount of food; his bodily machine is so regulated that the food which he takes is absorbed — that is he has a high availability of food; and he burns up little food in muscular work. Any one of these three factors may be predominant. Usually the fat man, however, eats more, absorbs more of what he eats, and is less active than the thin man. Lethargy and obesity are common associates. But, contrary to the general opinion, the lethargy and inactivity, which burn up less food, are the causative factors of the obesity, rather than that the obesity is the cause of the lethargy and inactivity.

On the other hand, the lean individual tends to eat less, to absorb less of what he eats, and to be more active than the obese person. We are all familiar, however, with the lean man who is a large eater. Of course, in some instances, leanness is merely one evidence of disease. Yet there are many lean persons who cannot adjust their digesting and absorbing mechanism so that they can absorb and get the benefit from more than a fixed amount of food value. Their machines seem to be set permanently at a certain level and anything in excess is waste. Often a lean person is thin on account of an excessive activity which is manifest throughout his waking hours. It seems to be impossible, for example, for such a person even to sit quietly reading for any length of time. Any task is performed with an extraordinary amount of unnecessary motions. Excessive activity is the reason why children from eight to fourteen years of age tend to be thin. At middle life most people tend to put on weight. Here the determining factor is usually activity. They have acquired a habit of taking a certain amount of food, and with the lessened activity natural at this time of life the usual outcome is an increase in weight. Transportation by trains, electric cars, elevators, and automobiles, communication by telephone and by post, labor-saving devices and other conveniences of modern life, all conspire with the variety and greater appetizing qualities of the diet to induce obesity. The incidental activities of everyday life are decreasing and we tend to eat more than we use up.

It is probably wise to make our mistakes on the side of a slight excess of food and of a slight amount of fat tissue. A slight amount of fat represents stored fuel of heat and energy. Furthermore, we find in the story of the cure of consumption and, indeed, in its prevention, an illuminating example of the importance of an

ample diet (in conjunction with other measures, to be sure) in resisting and conquering disease. On the other hand, while fatty degeneration of the heart as a dreadful complication of obesity has been discarded by the medical profession, it is true that an excess of weight, since fat is not a structural tissue, only stored heat, merely means an unnecessary burden. It must be carried about, supplied with blood, and entails increased work for all the organs. It is as if a man in a land of plenty carried constantly many pounds of provisions which he never would use.

Number of Meals a Day. Custom in this country has established the three-meal-a-day habit. This custom conforms to the conditions of our industrial life. Many people, however, deviate from this custom by eating from one to six meals a day. Ordinarily it is difficult to consume and take care of a day's ration in one meal. Certain individuals require several meals in order to enable their organs to extract food values from the ingested food. The important consideration is habit. Irregular meals will find the digestive functions prepared at a certain time to receive a certain amount of food. If the food is not forthcoming, Nature's remonstrances are usually made evident by a variety of sensations, often hunger, sometimes faintness, headache, lassitude, and the like. Likewise, Nature resents the insult of a large meal at an unaccustomed hour. It is not too much to say that food should not be taken continuously. Probably the two-meal habit with a wide interval for rest of the digestive functions has much to recommend it. For the average individual the chief concern should be that his meals, two or six in number, should be reasonably regular. Undoubtedly a goodly share of the usual Monday depression is due to the custom of departing, on Sunday, from regular habits of eating. It also follows that the decision of

when the hearty meal should be eaten depends largely on the question of habit. It is well known that a hearty meal induces a soporific tendency which is merely an indication of the concentration of the bodily energy in the digestive tract. Consequently the hearty meal should, by preference, not be habitually taken with a prospect of bodily activity immediately afterwards.

Balanced Diet. It would seem fairly simple to arrange a diet on the basis of amounts, as one can consult tables of food values and select sufficient calories to supply the necessary amount of food. But it is necessary to know more than the total amount of calories. The diet must also be well balanced between the food factors. Unless the diet is reasonably balanced, we have no right to assume the average assimilation, and, in fact, there is a great deal of evidence to the contary. We all require a balanced diet to secure the most effective nutrition. As we have seen, the proteins are the tissue-builders, while the carbohydrates and fats supply the fuel. While a man could live on a diet of pure protein, he could not survive on a diet consisting only of fats and carbohydrates. The main question, therefore, is the amount of protein a diet should contain.

A diet exclusively of proteins will support life, but the individual subsisting on such a ration will suffer from a variety of intestinal and other derangements which are merely Nature's protest against such an ill-advised proceeding. An excessive diet of protein is often accompanied by immediate disorders of a varying kind, but there is also considerable evidence that such a diet eventually causes damage to the kidneys and to the other organs. In some mysterious fashion certain forms of rheumatism and neuralgia are associated with, even if not caused by, an excess of protein food. Scientists are not so certain as the laity about the direct relation between protein, especially meat, and gout. It is

certain that the disturbance in gout centers about a protein derivative, uric acid, which is found in large amounts in such protein foods as sweetbreads, liver, and kidneys, and to a less, but still considerable, extent in ordinary meat. In families which suffer from gout there is often a history of excessive meat eating. A constant and stern adherence to a reasonable intake of food with a moderate amount of protein, often relieves the gouty sufferer from what seems to be the belated penalty of the earlier indiscretions, either of himself or of his ancestors, in excessive protein consumption.

Experiments have also indicated that one result of the consumption of an excess of protein is an increase in the bodily heat. This increase is marked with protein consumption, less marked with fat consumption, and is hardly noticeable after the intake of even an excess of carbohydrates. This again illustrates how nearly practice coincides with science; namely, that in the heat of the summer or of the Tropics one is probably more comfortable if the amount of protein intake is not excessive. The fat intake also should not be excessive, but carbohydrates may be taken in abundance.

A diet with too little protein causes an inability to repair and replace bodily tissue, a loss of strength, anemia, and a diminished resistance to disease.

Carbohydrates alone cannot support life, and if they are taken in excess of the requirements of the body the excess will be stored up as fat. Such an excess of carbohydrates may give warning of the condition by digestive disturbances. While we cannot as yet directly associate diabetes with an excessive consumption of carbohydrates, a possible relation is evident. A diet with insufficient carbohydrates tends to produce a harmful condition of body associated with an increased acidity of the structures.

A diet of fat alone cannot support life. An excess of fat in the diet promptly appears in the feces and is wasted. Many people cannot take in and absorb more than one hundred grams of fat a day without digestive disturbances. Carbohydrates and fats, since they do the same work, can be used interchangeably, the essential difference being that carbohydrates can be assimilated in almost unlimited amounts, while the fats cannot. A further and very practical difference is that the carbohydrates are derived from a large variety of foodstuffs which can be served in many palatable forms. The variety of fats is not great and foods of marked fatty content, as butter, cream, and the oils, are not appetizing to many people. A curious nausea and loss of appetite often follows an attempt to increase fats in the diet to any considerable degree. An insufficient supply of fat, while theoretically undesirable, can be compensated for by an increase of the carbohydrate intake. So far as known, the ill effects of a fat deficit in the diet are due to the excess of carbohydrates.

Thus it is obvious that the balance of foodstuffs in the diet is an important factor in health and disease. According to the best figures the proportions of foodstuffs should be 100 grams of protein, 150 grams of fat, and 350 grams of carbohydrates. About ten per cent of the food values of a diet should be derived from protein food, and at least half of this protein should be of vegetable origin. Experiments have shown that it is possible to live and maintain strength on thirty grams of protein per day, so that it is probably true that we, as a nation, eat too much meat. A proper diet should have the proper proportions of foodstuffs and should be slightly in excess of the amount required to repair tissue and furnish energy, so that there may be a reserve of fuel in the body.

If we examine roughly the combination of foods that are constantly used, we find a reasonable balance. Meat, which is high in protein, is rarely eaten alone, but in combination with potatoes and other vegetables, which are mostly carbohydrates. Bread and butter is an almost universal combination and it provides a balanced ration. The Italians add cheese — fat and protein — to their macaroni — carbohydrates. Everywhere there is a universal tendency to secure a balanced combination of food.

Under certain conditions of hard work it is necessary to increase the amount of food, while the requirements of a sedentary life are so slight that the food should be diminished. Yet the general proportion of the foodstuffs should be maintained roughly, whether the body needs 1,500 or 9,000 calories. The old superstition largely prevails that active and particularly athletic men need a large amount of protein. It is true that they use and therefore need more food than the inactive person, but repeated experiments have shown that their requirements indicate the consumption of the same percentage of proteins as the inactive person. The athlete, like the engine, relies on fuel, and the fuel in the case of the athlete is carbohydrates and fats. Consequently beef, while in limited amounts it is the basis of the formation of muscle, in excess does not furnish an excess of energy, but rather handicaps by subjecting the taker to the penalties of an excessive protein diet.

Bulk of Food. The concentrated food tabloid, which will give an adequate food value in small bulk, has been the cause of much wasted effort. In point of fact it is highly desirable that we eat bulky foods and avoid, to a certain extent at least, the concentrated foods. Food bulk furnishes the stomach and the twenty odd feet of intestine with material on which to work. Bulk increases the activity of the bowels and helps

to relieve that much-underestimated evil peculiar to civilization — constipation. Many foods, such as celery, spinach, lettuce, the group of green vegetables, and the various fruits, have so little food value as to be almost negligible, and yet experience shows that they are of great value in furnishing bulk. Of course, one could not live exclusively on such substances, but they should play an important part in the daily ration. In addition to their value for bulk, it seems probable that they may contain some of the mysterious and important vitamins.

Vitamins. If an individual takes a sufficient number of calories of clean food for his requirements of tissue growth and repair and for his energy, and these calories are properly balanced as to proteins, carbohydrates, and fats, and if he takes sufficient water and mineral salts, can we guarantee that he has all the elements necessary to maintain life and health? Such a question has to be answered in the negative. There are other mysterious substances of no food value and of unknown chemical composition, which, in our present state of ignorance, we call vitamins. How many there are, what they are, and how they act, we do not know. Bitter experience, and not science, first acquainted us with the disease conditions associated with a lack of vitamins. The best known of such diseases is scurvy. When sailors returned from a long cruise on a sailing vessel, it was occasionally found that some of them were suffering from a peculiar disease called scurvy. This disease was promptly cured by the addition of fresh fruit to the diet. Likewise, bottle-fed babies, particularly if the milk is prepared and is not fresh, occasionally suffer from the same disease. A little orange juice suffices to cause a prompt and complete recovery. Under these conditions the calories of the diet are usually abundant, but there is a lack of something which

the body requires and which fresh fruit and vegetables and milk will supply.

Beri-beri, another disease condition with an entirely different symptomatology, can now be put in the same category. This disease has been described in the Orient and in Labrador and is seen occasionally all over the world. It is most commonly associated with the large use of polished rice and the exclusion of fresh meat and vegetables from the diet. The disease may be prevented and cured by the use of whole rice. The inference is that there is in the covering of the rice a substance of no caloric value, but nevertheless essential to life. This disease has also been noted in people who live almost exclusively on other substances which have been so treated in manufacture as to lose the outer covering of the grains.

Still another disease of still different symptomatology, apparently caused by a lack of vitamins, is pellagra. This disease was long associated with a diet almost exclusively of maize or corn and was most common in Italy. Cases have been fairly frequent in our Southern States and occasionally it has appeared in the Northern States. It was not until officers of the U. S. Public Health Service were able to reproduce the disease by feeding healthy persons on a restricted, one-sided, mainly carbohydrate (cereal) diet, including grain, but excluding meat, that we had a clear idea of the causation of pellagra. This experimental diet contained 3,000 calories a day.

It seems probable that we shall find other disease conditions due, not to a lack of calories and, usually, not a lack of balance, but to the absence of these mysterious vital substances, which a very restricted diet may not include. Perhaps rickets in children is related to this group of diseases. We are only at the threshold of knowledge of these conditions. The

startling facts concerning the relation of polished rice to beri-beri have aroused apprehension concerning all the highly milled cereals. As civilization has advanced the highly milled products, which contain less of the husk and more of the kernel and thus less of the vitamins, have increased in use. Then, too, experiments seem to indicate that the alkali which is found in baking soda tends to destroy the vitamins of the bread and thus still further diminish the already low vitamin content of the bread from the highly milled cereal. This may prove to be a problem of increasing seriousness since, particularly among the poor, there has been a marked falling off in the use of the vitamin-rich foods ordinarily used, such as fresh eggs, fresh milk, meat, fresh fruits, and vegetables. However, there seems to be little danger unless the diet is almost entirely of a limited variety of vitamin-poor foods, and it requires a really extraordinarily small amount of these mysterious substances to insure health. It is encouraging that new sources of vitamins are being brought to light, such as brewer's yeast which is very rich in them. But these facts need serious consideration and strongly indicate that it is always wise to include in our dietary some fresh foods, milk, eggs, meats, fruit, and vegetables. Perhaps the fundamental lesson is that foods in their fresh natural state contain certain substances which are necessary to life and which, consequently, are superior to the food products which have been artificially treated to any great extent. This fact is not yet apparent from chemical analysis or from the caloric value of food.

Anaphylaxis, or Hypersensitiveness to a Foreign Protein. Recent brilliant investigations have thrown light on the long-known curious phenomena that certain persons are poisoned by partaking of certain foods. This form of poisoning may manifest itself in many ways. Perhaps the most common manifestation is the

rapid appearance, after eating, of urticaria or hives, an intensely itching variety of skin eruption. Often gastro-intestinal disturbances of varying intensity are present. There may even be asthmatic attacks. In brief, there is the picture of acute poisoning, varying from a trivial attack to one of great intensity. This phenomenon has been found to be similar to the mysterious one known as anaphylaxis.

It had been discovered previously that some animals can be poisoned and even killed by the double injection of a foreign protein. The first injection serves to make the animal sensitive to the second injection of the same protein. If a guinea pig is inoculated with any foreign protein — the white of an egg or the protein from a horse or a sheep — a second injection of the same protein, even in small amounts, will usually kill the animal. The first injection is quite harmless and the second injection, if of any other protein than that given before, is equally harmless. Other discoveries have followed in rapid succession. It has been found that it is not necessary for the protein to be injected. It can act when inhaled, and hay fever is already a classical example of this form of anaphylaxis. In true hay fever a person is somehow sensitized by inhaling the pollen of ragweed. This pollen contains a relatively small amount of protein, but the phenomenon is apparently entirely a protein characteristic. Such a person is poisoned and has hay fever whenever he inhales ragweed pollen.

Other people are similarly affected by the proteins of other grasses and weeds. Then still others are affected by horses, dogs, cats, and rabbits. This condition usually takes the form of asthma and is known as horse asthma, dog asthma, and so on. It has developed that the same phenomenon takes place in certain susceptible people when the foreign protein is taken in the

mouth. It is true that the action of the substance is most certain when it is injected and least so when taken in by mouth and thereby subjected to the action of other substances as well as to the digestive juices. Thus, in many cases, it has been found, anaphylaxis or hypersensitiveness is the cause of poisoning by berries, fish, eggs, almonds, and the like. Many of these substances contain so little protein that it is negligible as a food, yet it is the protein part which causes the poisoning. This list could be extended to include many foods. A striking illustration of anaphylaxis is occasionally seen in the weaning of infants. Cow's milk poisons certain infants, yet goat's milk will not.

Many details of the explanation of this phenomenon of anaphylaxis are still lacking. We do not know how the individual becomes sensitized in the first place. We know that a general tendency to anaphylaxis seems to run in certain families. Yet this sensitiveness may take the form of hay fever in one member of the family, horse asthma in another, almond or egg poisoning in a third, and so on. Anaphylaxis is much more frequent in early life and the tendency is often outgrown. The phenomenon of anaphylaxis is often very striking even with small amounts of protein. Clinical tests for this condition are being developed which consist of simply rubbing the food in question upon scratches on the arm. If there is hypersensitiveness, a swelling appears about the scratch with a certain food, which is not present with other foods. Investigations for the relief of this condition are being undertaken and indicate that the body can lose its abnormal sensitiveness to these poisons by being repeatedly subjected to carefully graded amounts of this foreign protein.

In general, except under the best medical supervision, it is wisest to avoid most carefully the foods to which we are hypersensitive. This phenomenon of anaphy-

laxis is undoubtedly a large factor in many of the digestive upsets which recur repeatedly in some people, and it is probably a more important factor than we, in our limited knowledge, now realize.

Influence of the Emotions on the Food Problem. Many of the lower animals live and maintain their health on a monotonous diet, and some human beings are able to do the same. To the really hungry man food is food and his appetite requires little whetting by pleasant surroundings, clean table linen, appetizing sauces, and new and unexpected combinations of food, and the like. Yet the absence of these things and even the contact with food which is essential to its preparation occasionally suffices to make eating well nigh intolerable to a sensitive person. Food values and calories are forgotten. Nor are the lower animals exempt from these sensations. Under such circumstances the distinction between the animal and the artificial machine becomes clear.

The profound influence of the emotions on the digestive apparatus has been well shown by the experiments of Dr. Walter B. Cannon, of the Harvard Medical School. By means of the X-ray and a meal containing an impenetrable substance like bismuth, the digestive system of a cat can be observed to manifest remarkable and sudden changes in the hitherto placid activity when the cat becomes enraged at a dog.

The nausea of fear, the diarrhea, the sweating, and the frequent urination so frequently seen at times of stress and excitement, as before student examinations and athletic contests, are common evidences of the influence of the emotions on bodily functions. Emotions, especially in certain individuals, have the power of deranging seriously the digestive functions. Fatigue, likewise, is an important factor which will put awry the nice mathematical tabulation of food values.

Granted that these considerations play only a small rôle in the completely healthy person, yet, under the conditions of our so-called civilization, the factors of emotion and fatigue must be considered seriously. Under the influence of extreme fatigue or grief, a person may grow thin on an adequate diet, or various digestive disturbances may arise which are attributed, only too often, to food and not to the actual causes, the emotions. A worried man attributes his indigestion not to his worry but to his beef, notwithstanding the fact that he has eaten beef for many years without experiencing any difficulty.

On the other hand we see and we constantly make use of the favorable effect of pleasure on the digestion. Pleasure in the company, the serving of the food, the attractiveness of the food combinations pave the way to a hearty meal, eaten with enjoyment, and completely assimilated.

A considerable variety in foods is agreeable to many people. This fondness for variety often extends to a lack of appetite and loss of assimilating powers when the same cooking is eaten day in and day out. Moreover, a wide variety of foods is usually an insurance against those disease conditions associated with a deficit of vitamins.

Cooking of Food. To a large extent cooking of food is a matter of custom, although, of course, cooking does make the food more tender, — that is — more easily acted upon by the digestive juices. But from the viewpoint of health cooking is chiefly important, not from any modification of the food, but because it kills harmful bacteria and parasites. Milk, one of the few foods which is consumed in a raw state, is an instance of how dangerous an uncooked food may be. Cooking removes much of the water from foods and also some of the juices. While it makes meats more palatable,

it often makes them slightly less digestible, and slightly less rich in nutrients. Vegetables are also made more palatable and the structures are so altered as to make them more easily digested. Excessive cooking makes vegetables both unpalatable and indigestible. The despised fried foods deserve their bad reputation only to the extent that the fat added may be unnecessary or unpalatable. But on the whole cooking is almost entirely for the benefit of the palate.

Cost of Food. Much of the recent discussion of foods has been devoted to the high cost. As a matter of fact the cost of eating is high, because custom and fashion demand the use of products which are not in themselves of unusually great caloric value. It is perfectly possible to arrange a satisfactory diet of sufficient calories at a low cost of the raw materials. A rice diet of 2,500 calories can be obtained for about four cents, while the same number of calories in shad, for example, would cost over sixty cents. What can be done in the way of procuring food value at slight cost is shown in the lunches which are served in schools where the cost is about one cent per hundred calories.

The main cost of food lies not so much in the cost of the raw materials as in the preparation and service. The poor often buy prepared foods of low caloric value and at considerable expense rather than the raw foods of high caloric value at low cost. Then in the case of the poorer classes the cost of rent is fixed, so that they economize in the elastic cost of food. As a result the poor get too few calories and the consequent undernutrition bears an important relation to disease. Poverty markedly affects the food supply of a family, and yet a thorough understanding of food values would permit them to economize on food and at the same time secure adequate calories. The

dissemination of such knowledge is extremely important and should be begun in the public schools. It is vastly more essential to health than the instruction in cookery.

Rations. The average person, through the experience of years and customs, eats a well-balanced diet of sufficient calories and pays no attention to food analysis. Nevertheless many diets are being arranged almost solely on a calorie basis. Scientific methods of feeding have been introduced into schools, hospitals, and sanatoria for reasons of economy and for reasons of health. All armies are fed on this principle, for, obviously, physical efficiency in armies is absolutely essential. Profiting by the bitter experiences in the past, the feeding of the modern army in the field represents to-day, especially in Europe, a splendid example of scientific feeding. Nothing is left to chance. Each man receives a ration which is sufficient for the average man at hard work. Such a diet is monotonous, but there is often opportunity for "extras", usually in the form of foods of no great food value, but which give variety, such as fresh fruits and the like. These rations allow about 3,500 well-balanced calories a day and include salt, tea, or coffee. In addition, there are included certain articles of food for the purposes of bulk and to supply vitamins. Such articles vary from the dried vegetables, often made into soup, to the vegetable sausage of the German army. Bread is the substance which is almost inevitably present in the largest amount, not only in weight, but also in calories. Bacon is a favorite substance, since it contains both protein and fat. Almost any diet contains considerable meat, but the days of rations almost exclusively of beef, salt pork, and bacon have long since gone, as such an exclusively protein diet was accompanied by marked gastro-intestinal disorders.

An interesting ration, made up to include sufficient well-balanced calories at the lowest possible cost, is the ration furnished by the Belgian Relief Commission. This commission had the problem of furnishing to large numbers of people a diet which should keep them alive, prevent disease, and yet be cheap. The daily ration was approximately as follows: Bread 11 oz. (or its calorie equivalent in flour); rice 1½ oz.; dried peas and beans ⅔ oz.; bacon ½ oz.; coffee ⅔ oz.; lard ½ oz.; salt ⅓ oz., sugar ⅓ oz. This ration was given to each person, — men, women, and children. The total number of calories is about 1,400, of which about ten per cent are protein. This diet is barely sufficient for life, and is not sufficient for hard work, but it was possible for the Belgians to exist, since the old, the young, and the small doubtless needed less. Probably the people were occasionally able to add vegetables and other products of their land and thus increase the food value of their diet as well as to relieve the monotony.

General Diets and Rations. The following table gives a rough estimate of a typical dietary for a man leading a more or less sedentary life.

	Approximate Calories
Breakfast	
Orange or grapefruit	100
2 eggs	166
2 Vienna rolls	258
butter	119
coffee with milk and sugar	100
Total	743
Luncheon	
12 soda crackers	300
1 pint milk	325
Total	625

Dinner

	Approximate Calories
Soup, consommé	14
Roast beef	357
Potato	145
String beans or peas	13
Bread	100
Butter	119
Apple pie	352
Glass milk	157
Total	1257

These figures are based upon average servings of each food. The following figures show the approximate calories in an average serving of the more common foods. Strictly accurate figures can, of course, only be obtained by weighing each article of food and determining the exact food value from the tables showing the caloric values of the articles of the diet.

Average serving of:	Approximate Calories
Roast beef	350
Beefsteak (round)	185
Chicken (roast)	180
Bacon	190
Codfish	100
Turkey	285
Pea soup	160
Tomato soup	125
Butter	120
American cheese	90
Baked beans	300
Baked potato	150
Apple	75
Orange	95
Strawberries	40
Bread, baker's	80
Bread, home made	100
Apple pie	350
Sugar (cube)	30
Peanuts	125

In the breakfast menu, cereal with milk and sugar would add 100 calories, and an average serving of bacon would add 190 more. In the luncheon menu, cold meats with vegetables would give about the same total of calories. If black coffee replaced the milk at dinner, the food value would be decreased, for coffee by itself has no caloric value.

Special Diets. In general terms any special diet should only be directed towards the alleviation of some special condition and should always be under expert supervision. Many people, however, fearlessly undertake to prescribe diets for themselves, their families, friends, and even casual acquaintances. The general run of these amateur diets may be classified under the rather meaningless caption of " light but nourishing." Such diets are popularly assumed to be appropriate to minor illnesses, fatigue, and the like and are as much a part of the household armentarium as castor oil. Few of these diets are what they purport to be.

There are a few simple facts upon which an easily digested nutritious diet can be based. The nourishing factor of food depends solely on the food values and on nothing else. Hence jellies, no matter how palatable, depend for any nourishing quality on the substances from which they are made, and most of the jellies have few calories.

A completely healthy person takes care of all the food of any reasonable diet, but in ill health of any degree this may not hold. Fats are relatively hard to assimilate and, furthermore, much fat with food is unappetizing. Hence the natural prejudice against greasy foods and fried foods comes with reason. Likewise, pork and pork products and veal, which contain considerable fat, are harder to assimilate than beef. Furthermore, all food to be assimilated must be finely minced in the organism. Tough, stringy meats require

more work to be divided finely and so are harder to digest than tender meats. Cooking helps to solve this difficulty, not only in meats, but also in the case of grains and cereals. It stands to reason that if the first mechanical step of bringing food to a point of mincing is carried out, it helps digestion. Such is the reason for the preference of toast or zweibach over bread; and old bread is preferable to new bread, since aging after baking, like toasting, helps to break up the carbohydrates.

Such are the facts which make for an easily digested diet whenever one is required. That any diet should be appetizing goes without saying. In general " home made diets " are poor things, largely because they have no scientific foundation and they break up good food habits. Then, too, the amateur dietician almost inevitably considers that an important characteristic of any diet is limitation of food. A diet based on this consideration, even if correctly composed of bland and easily digested foods, tends to constipation since the bulky foods of low caloric value are usually eliminated on account of the supposed indigestibility. It is wise, except under medical direction, to stick to a reasonable diet of sufficient calories, which is well balanced and which contains sufficient bulk. The scales and our feelings are the best indices for our guidance.

Diets for Obesity and Leanness. There are many so-called diets for obesity and almost as many for leanness, all depending on the general principles of nutrition presented in the foregoing pages. The problem in obesity is merely the limitation of food values below the requirements of the body so that the body burns fat tissue. In a sense this procedure is partial starvation. Purgation may be employed in order to hurry the food through the digestive tract and thus reduce absorption. Furthermore, fluids may be restricted,

again in order to hinder the absorption of food. Occasionally a substance derived from the thyroid gland is given, for this increases the requirements of the body. The activity of the obese person is increased merely to increase his requirements of energy, part of which must come from his food.

The problem can be stated mathematically: the calorie intake minus the bodily requirements, largely influenced by exercise, equals the answer. If the answer is plus, the person will tend to gain weight. If the answer is zero, the weight will be stationary; and if minus, the person will be compelled to use his tissues as food and will lose weight. From the viewpoint of the individual the success of the treatment depends on the lack of discomfort and the bother he has in following it. For example, if a person's bodily requirements are 2,500 calories, to get thin he can be given 2,000 calories. If he takes his 2,000 calories in concentrated food, — bread, butter, meat, cheese, and sugar, he can eat very little and he will be hungry. On the other hand he would have to eat over twenty pounds of celery a day to get his 2,000 calories. Consequently he fills himself with foods of a low value, such as fruits, all the green vegetables, and the like. He avoids the foods with a high food value, such as sugar, which is pure carbohydrate, butter and oil, which are pure fat, cheese, bread, breakfast foods, and meats. Some of the cures for obesity, like the milk cure, limit the individual to one article of diet. Milk is not a concentrated food, as it is about eighty-eight per cent water and it takes about three quarts to make 2,000 calories. This gives the individual about twelve glasses of milk a day, which seems like a generous allowance. Of course some individuals may only require 1,500 calories a day, which merely necessitates putting the intake below that amount in order to lose weight.

A word of warning is necessary for those who undertake weight reduction on their own initiative. The body has become accustomed to the increased size and also to the diet of the individual. Sudden losses of weight and sudden changes in the diet may prove to be very disturbing to the entire bodily mechanism. Every physician has seen instances of nervous breakdown induced by such incautious violent changes. After weight reduction, it is usually necessary to continue careful dieting for some months, since any increase in the food intake will probably be accompanied by a gain in weight and the attempt to restore the previous size of the body. But after the weight has been stationary for a considerable period and the bodily economy accepts the low level as fixed, minor fluctuations in intake usually make little difference. It must be remembered that on a food intake, fixed approximately at the bodily requirements, the weight will be stationary whether the person is lean or fat.

In order to increase the weight the same principles of feeding are utilized and the patient reverses the practices outlined for the treatment of obesity. "Stuffing," however, has very definite limitations, as every tuberculosis sanatorium has experienced. Nature frequently rebels at persistent stuffing. This procedure calls for the ingestion of large amounts of the same kind of food and, usually, of considerable fat. The value of cod liver oil, for example, is mainly its high food value. Now the power to assimilate fat is definitely limited. By the use of food tables, however, it is relatively simple to increase markedly the food values, and through their use the common mistakes as to the values of foods may be avoided. The following brief table gives an idea of the food value of a pound (500 grams) of some of our common foods:

Beefsteak	1130 calories
Potatoes	385 calories
Wheat flour	1640 calories
Butter	3636 calories
Cheese	2285 calories
Codfish	295–335 calories
Lobster	130 calories
Cabbage	145 calories
Celery	85 calories
Breakfast foods	1700 calories
Milk	325 calories
Eggs	720 calories
Canned baked beans	600 calories
Roasted peanuts	3177 calories
English walnuts	3305 calories

Fads and Fancies in Foods. It seems to be an essential characteristic of human nature to desire to experiment with food. Of course such experimentation in the past, rather than science, has been the main source of our knowledge on this subject. No better illustration of this could be given than Lamb's fanciful account of the important discovery that roast pig was fit for human consumption. And it is to be expected that as people have always experimented with their diets, so they probably always will. The topic of food ranks with that of the weather as a never failing subject of conversation and discussion. Such discussion is always personal. But it should be remembered that the individual experiment is of no value when it runs counter to similar experiments which number thousands. Nearly all the experiments with food are old and there are ample data to decide as to their wisdom or worthlessness. Apparently, however, people like to diet, usually on their own initiative, and many times the diet which forms the basis of their conversation and which they pretend to like to keep is largely a fiction or is mainly characterized by quiet exceptions which " they do not count."

Vegetarianism. Many people have adopted a so-called vegetarian diet, some for humanitarian reasons, others because of the belief that it is better for the health. It is not a non-protein diet, as many people think, that the vegetarians advocate and use, but a non-meat diet. The cereals and grains average roughly about ten per cent of the food value from the protein content, an excellent proportion. Furthermore, the protein from the vegetable is the source of the animal protein. The meat eater gets his protein in part from the vegetable kingdom, and in part from the animal kingdom which makes it from the vegetable kingdom. Thus the difference between the two diets is not so great as appears at first. On the other hand it is probably true that meat protein is somewhat more easily taken care of than vegetable protein.

While no absolutely positive statement can be made, it is probably desirable that man should use both the vegetable and animal forms of protein. Man is naturally an omnivorous creature. While some animals are exclusively meat eaters and others exclusively herbivorous, both types are healthy. For food animals, including man, prefer the herbivorous animal, since, as is well known, the carnivorous animals have a so-called strong taste. The difference is in palatability only. It is extremely doubtful if the type of food has any determining influence on the ferocity or mild temper of man or beast. Carnivorous animals slay for food and not for lust. The ferocity of a meat eating animal can be matched by that of the herbivorous animal and so, too, can his courage. While it is probably true that many people eat too much meat and are harmed by it, moderation and not vegetarianism is the real solution of the difficulty. Vegetarians have to face the difficulty of securing a properly balanced diet. This is particularly true if they exclude eggs, milk, and

the milk products — butter, cream, and cheese. They may easily increase the calories by taking a larger amount of sugar, but the diet will be unbalanced and in taking a carbohydrate excess, they may be making trouble for themselves. A glance at the dietary tables will show that this difficulty is by no means insurmountable, especially if they add to their diet peas and beans and similar foods which are particularly rich in protein.

Vegetarianism, it is true, has its advantages. For one thing, it almost inevitably supplies sufficient bulk and so there is rarely any trouble from constipation. It is also true, as the exponents of vegetarianism claim, that certain vegetarians can perform any of the mental or physical feats which meat-eaters can. Undoubtedly many people would be benefited by taking more food from the vegetable kingdom, but strict vegetarianism cannot be recommended. Nature apparently intended us to be omnivorous, and, in addition, vegetarianism runs too close to the dangers of carbohydrate excess.

Fletcherism So-called. In recent years a food fashion of prolonged mastication of a limited amount of food has been revived. Like vegetarianism, Fletcherism represents a revolt, more or less wholesome in moderation, against the tendencies of bolting food and overeating. It is, of course, desirable that the food be properly minced before it is swallowed. Mastication is, in addition, good for the teeth and mouth. Yet many toothless or nearly toothless individuals enjoy good health provided the food is somehow subdivided. So there is no basis in science or experience for excessive mastication.

The limitation of food under the system of Fletcher has to meet the fact that the bodily requirements determine the number of calories necessary and that the amount of food and the number of calories are not necessarily parallel. Most people wisely prefer a

margin of safety in the amount of food. When necessary, it is granted, certain persons can maintain life on a small number of calories, nevertheless, if the activity of the body burns up a certain number of calories, that number of calories must be supplied from the food, and, failing that, from the tissues, — a condition which amounts to partial starvation. A limitation of food below the bodily requirements in disease or in health, by starvation, either voluntary or involuntary, whether under the guise of a food fad or not, is inevitably harmful.

Other Fads. Among recent fads is the so-called buttermilk or sour milk diet as advocated by Metchnikoff. The original theory was interesting and was, in part, that the bacteria, which soured milk, could drive out of the intestinal canal all the harmful bacteria. By taking buttermilk or the artificial preparation made by fertilizing milk with cultures of lactic acid bacilli, in the first place, one is taking food. In the second place these preparations are all slightly laxative and, since many people are chronically slightly constipated, the effect is beneficial. One may, in part, especially if large quantities of milk be taken with the lactic acid bacilli, supplant the bacteria which do not find milk so favorable a medium for growth as the lactic acid bacilli. The beneficial effect of this change of bacteria is probably not of great consequence.

White Meat, Red Meat, and Fish. Red meat comes periodically into violent disrepute. Popular opinion holds it to be the active cause of rheumatism and most of the various ills of the flesh. Outside of minor differences of a technical character, there is little difference, chemically or in any other way, between red and white meat. The same statement holds true of the meats of various animals — beef, chicken, and fish. The real consideration is the amount of protein con-

sumed. Fish contains considerably more water than animal meat and is, consequently, less rich in protein, weight for weight. It is also obviously easier to eat more protein in a beafsteak than from squab, but protein value for protein value there is little difference.

Predigested Foods. The predigested foods of which we read and hear so much have little to recommend them. All foods have to undergo changes before they are absorbed and many of these changes are still unknown to us. Food can be prepared mechanically and thus by being minced or softened be more ready for the action of the digestive juices, but there is no evidence that any chemical preparation of food (this is what predigested foods mean) assists to any appreciable extent the assimilation of food.

Candy. Most of us have been brought up in the belief that candy is bad for us, but scientific studies have proved the contrary to be the case. Candy is, or should be, practically pure sugar, and has, therefore, a high caloric value. The objection to candy is that it is usually eaten at the wrong time, between meals — and so impedes digestion. Saccharine may be used in place of sugar as a sweetening agent, but this substance has absolutely no food value.

A word should suffice to dismiss all the old superstitions concerning the particular value of certain foods for certain functions. None of these beliefs has the slightest foundation in fact. They are all as groundless as the belief that the eating of fish creates mental ability.

Preservation of Food. Under our present conditions of life it has become necessary for us to find ways for preserving food, for only a small part of what we eat is fresh and has not had to be transported long distances. A glance at the articles of our table tells us that the orange may come from Florida or California, the banana from further away, the tea or coffee from

China or Brazil, the meat is usually Chicago beef, and so on. The inhabitants of our largest cities would starve if preservation of food had not made its transportation for long distances possible.

The preservation of food depends upon only one principle, the elimination of as many bacteria as possible, for it is the presence of bacteria that causes nearly all the changes which we know as spoiled food. The particular kind of food determines the kind of preservation necessary. Tea, coffee, sugar, and flour, for example, are dry substances and are preserved in ordinary dry vessels. Bacteria like moisture (many of them require moisture) and they usually require air. Since there are bacteria in the air, air-tight packages often suffice for the indefinite preservation of certain foods, provided that they are bacteria-free originally.

The use of cold or cold storage is the most important method of preservation of food which we use. Cold prevents the growth of bacteria, but it may not actually kill them. It has been shown that food which is kept cold all the time is not harmed; only a certain amount of the fresh taste is removed but all the nutritive values are retained. But food should not be allowed to become warm and then be placed in the cold again. If this is done, the bacteria may grow rapidly and certain changes may take place which make the food unfit for human consumption and may cause disease.

Eggs are now commonly preserved in cold storage. If placed directly in the cold, when they are fresh, they keep for years without spoiling or losing their food value. Eggs may be preserved by other methods, the most common being to paint them with shellac to keep out the air, for bacteria in the air can penetrate into an egg-shell. Eggs may be tested for freshness by the candle method or by floating them in a briny solution. Fresh eggs are evenly translucent and will not float. Cold storage

eggs have a peculiar flavor, but they are as nutritious as fresh eggs and do not cause disease. Indeed, while a few people are susceptible to eggs and are poisoned by them, there are few cases reported where disease has been caused by eggs.

The second method of preserving food is the already mentioned method of keeping it free from air. This is done in the case of canned or bottled goods, although most canned goods, in addition, are heated and the bacteria killed before the can is sealed. Practically everything may be preserved by this method, for, if the food is put up without air, it is practically impossible for the ordinary forms of bacteria to grow and thus cause decay. Furthermore, the possibility of the introduction of bacteria by the air is eliminated. The tin used in canned food is practically harmless, and there have never been any cases of poisoning due to canning. The unpleasant experiences in the Spanish-American war were due to the fact that the food was bad when it was placed in the cans. The claim is often made that the best foods are usually sold fresh and that the second grade products are used in canning. With the tremendous growth of this industry and with increased facilities of transportation many canneries raise foods for the express purpose of canning, so that they use the best products. Canned goods, however, do give an opportunity for the adulteration of food, a common illustration being the use of copper to make peas look green. This in itself is not harmful, but is unnecessary, as are the other methods used to make canned goods resemble the fresh article. Canned goods should be served shortly after being opened, or else, with the inevitable introduction of bacteria, they will spoil rapidly. The dangers from canned goods are merely the dangers which arise from dishonesty and carelessness and these can be eliminated by inspection.

The third method of preserving food is by drying. A good illustration of this is pemmican, which consists of strips of meat cut into thin slices and dried carefully. Vegetable matter and fats may be added so as to give a balanced diet. This prepared pemmican can be kept for a long time without spoiling. Beef and vegetables can be preserved by drying, for, as a result of the loss of moisture, bacteria find it difficult to increase and thus spoil the food.

Food is also preserved by the use of preservatives, which either kill the bacteria or hinder their growth. This method was rampant a few years ago, but, due to considerable publicity, it has practically ceased as far as the injurious preservatives are concerned. Boric acid, salicylic acid, and formalin are some of the common preservatives. In large amounts all these substances are detrimental to health and some seriously affect the food. With the increasing use of preservation by cold and by canning, there is no place for such methods. Salt is a common preservative, especially in the case of fish, which, preserved in this way, will keep for years. Sugar is the ordinary preservative used for fruits, while alcohol is frequently used for many foods.

Smoking is a perfectly harmless method of preserving food, but it is limited entirely to meats, as smoked ham and beef, and to fish.

The final method of preserving food is by cooking, that is by cooking thoroughly. Any thoroughly cooked food is safe, for the bacteria are all killed and the food will keep indefinitely, provided that other bacteria do not enter. This method is used in connection with canning. Partial heating, or pasteurization, is used to preserve beer and milk. Evaporated or sterilized milk is preserved in sealed vessels after the bacteria have been killed by heat.

Bacteria and Food. In discussing the preservation of food the importance of excluding bacteria from food, of hindering their growth there, and of killing them in food wherever possible has been emphasized. The effect of bacteria on food varies with the kind of bacteria and with the kind of food. Fish, for example, is a good culture medium for bacteria on account of its chemical composition, especially the high water content, and, furthermore, bacteria, and harmful bacteria at that, find easy access into fish. A not unusual action of bacteria on fish is to make it highly poisonous. Hence fish should be eaten as fresh as possible and well cooked. On the other hand few of us like our beef too fresh. If kept, certain changes, partly chemical and partly bacterial in origin, soften the fiber and make it more tender and more palatable. But this same flavor, like the highly regarded " gamey " flavor of certain game birds, is merely the beginning of the process of spoiling or putrefaction. If the meat is cooked thoroughly, the bacteria are killed and the changes in the meat do not interfere with its nutritive value nor do they cause disease. In cheese, however, bacteria are allowed to grow and the flavor depends on the partial decomposition induced by the bacteria. The fermentation of wine and the souring of milk are also due to bacteria, but their presence and the partial decomposition of the food are not necessarily harmful.

In general, preserved foods have the same food value as the raw product. This is particularly true of cold storage foods, as such foods are unchanged. In dried foods, since the water is removed, the food is concentrated and, consequently, the food value is higher. In food preserved by sugar, the sugar, of course, introduces a substance of high food value. Unlike most foods which are little changed by preserving, milk is consider-

ably altered, due to the fact that prolonged heat is necessary to evaporate the water. The Food and Drug Act has, fortunately, put a stop to the sale of many of the condensed milks which were originally merely skimmed milk and sugar. Improvement in the methods of preserving milk promises to offer us either an evaporated milk, or, preferably, a powdered milk (since dry milk is less subject to bacterial contamination) which can be used safely.

It is impossible to say, with accuracy, that one method of preservation is better than another. The deciding factor is the food to be preserved. Often a combination of methods is used, since all aim at the same result — that of preventing the growth of bacteria. When foodstuffs can be so treated, heating to kill the bacteria, and sealing, as in a can, and then the maintenance of cold afford every security for the wholesomeness of the preserved food.

It is often difficult or impossible to predict with certainty whether a partially decomposed food will disturb the human organism or not. This disturbance depends on the nature of the bacteria and the changes in the food.

The safeguarding of food depends, in the first place, on the careful inspection of the original food supply, *i.e.* the animals used as food should be healthy. Then there must be adequate sanitary care in the treatment of all food products. Preserved foods, in particular, should be supervised carefully throughout their entire course.

Food may cause disease because the material itself is poisonous, as is the case with mushrooms. Or it may happen that the food has acquired certain poisons, as is instanced in the case of the partridge which has eaten some substances that do not poison the partridge, but the bird, when eaten, is highly poisonous.

The Pure Food Law. The Pure Food Law, about which we have heard so much, is not a pure food law at all, but simply a law to prevent misbranding. The law was not actually passed as a health measure, but as a protection to certain industries, notably farming. Substitutes for farm products may be excellent for food, but they ought to be sold as substitutes. Oleomargarine, for instance, is as high in food value as butter and there is no reason why people should not eat it. The only point is that oleomargarine should be sold as oleomargarine and not as pure butter. The Pure Food Law does prevent the indiscriminate introduction of extraneous and possibly harmful substances into food products. The law is a step towards honest products, and health depends largely on honesty.

Food and Disease. In addition to the diseases already mentioned as caused by food, there are two other types of food poisoning: (1) In which the food merely acts as the carrier of disease bacteria; (2) in which certain changes in the food have been caused by bacterial origin and the eater is poisoned primarily by the changed food and not by the bacteria.

Under the first heading, in which the food acts as the carrier of disease germs, are included the diseases which may be carried by milk and water, such as typhoid fever, cholera, tuberculosis, septic sore throat, and the like. Milk and water are so important to the individual and the community from the point of view of health and sanitation that separate chapters are devoted to them. There is a form of paratyphoid fever (like typhoid fever) which is frequently carried by sausages, and which was formerly known as sausage poisoning. Other intestinal diseases due to special bacteria are less commonly caused by the presence of bacteria in the food. Thorough cooking, to which sausage are not always subjected, will kill the bacteria and prevent disease.

Two diseases are derived from food and in no other way, trichiniasis and tapeworm disease. Trichiniasis is caused by minute animal parasites — trichinæ — in pork which appears measly when the parasites are present. Fortunately they are entirely destroyed by proper cooking of the pork, but otherwise they get into the body and cause muscular rheumatism. Properly inspected pork will not contain trichinæ. The other animal parasite of importance in this connection is the tapeworm. Beef, pork, and fish each has a special tapeworm. The beef tapeworm is the most common in this country. These parasites are also killed by proper cooking. Consequently if all our food were cooked thoroughly and not contaminated subsequently, these diseases due to animal parasites could not be transmitted by food.

Tuberculosis may be carried by food, usually milk. Typhoid fever is not a disease of the lower animals and so it can get into food only through gross contamination in handling. Careless and unsanitary methods of handling food are the cause of many diseases. But the problem of food-handling is only a problem in decent handling. Clean hands are an essential in this procedure. The principle of infection is the same as that which made people do away with the common drinking cup and the roller towel.

There is a considerable group of diseases due to changes in food and to the changed food. This group includes a number of complex conditions. We have little definite knowledge of this whole subject, not much more in fact than the person who, when he has diarrhea in the summer, boldly complains that he has ptomaine poisoning and is quite satisfied with his diagnosis. Some of the cases of ptomaine poisoning are due to the fact that the food carries special bacteria; others are merely anaphylaxis. But others remain,

chiefly occurring during hot weather, when food is difficult to keep, which are best explained as follows. For some reason, probably largely due to bacterial action, a food breaks up into different parts. While the food, as a whole, is not poisonous, some of the parts may be. This is particularly true of protein foods. All protein foods can be broken up and furnish some substance which is highly poisonous. The result of the action of a poisonous fraction of food is called ptomaine poisoning. Since we have known more about bacteriology, we know that many cases of ptomaine poisoning, so called, are really cases of paratyphoid fever, dysentery, and the like, and that the disease germs enter the body through water or food, although the water or the food in themselves were fundamentally wholesome.

Conclusions about Food. The problem of food in relation to health seems complicated, but, in reality, the solution is simple. The important considerations are: a reasonable knowledge of food values and food balance; an appreciation of the importance of bulk and fresh foods; the establishing of good food habits in regard to regularity of eating and water drinking, and the insistence upon the ordinary principles of decent cleanliness from the source of the food to the consumer.

Bacterial contaminations of food and the early spoiling of food depend on unclean methods somewhere. Official organized inspection is necessary away from home, but care in the household is just as important. Since our living, our activity, and our health depend upon food, a better understanding of food should lead to a longer life, increased activity, and better health.

CHAPTER III

Air

As is the case with food, our present-day opinions concerning the air are far different from those held only a few years ago. We now know that an abundant supply of moving, pure, fresh air is the proper and simple solution of the problem of the hygiene of the air. With the confirmation of this relatively simple belief, the mysteries and the superstitions of former years have, to a large extent, vanished.

Air is the most necessary element for life, as we can live for only a few moments unless the process of respiration continues. In respiration we take in oxygen from the outside air and give back to the air carbon dioxide. Food, as has been stated, is burned to supply the body with heat and energy so that the bodily processes may go on. For this combustion, as is the case in any burning, oxygen is necessary. Thus respiration supplies us with oxygen for the burning of our food and, when the combustion has taken place, gives off the waste products.

Metabolism Cycles. The process of combustion in the animal organism discloses interesting cycles which involve nearly the whole scheme of Nature. In the carbon cycle, for instance, we take in oxygen and give off carbon dioxide. The carbon dioxide thus passed off into the air is taken up by all kinds of plants. Many of these plants are edible and are eaten by animals for their carbohydrates. The plants have worked over the carbon dioxide, for their own pur-

poses, into sugars and starches, and the latter are taken by man for food. With the creation and utilization of energy and heat carbon dioxide is given off again.

The so-called nitrogen cycle is also interesting. Nitrogen is the basis of all protein food. Plants take up nitrogen, either directly from the air which is four-fifths nitrogen or from the soil. A rich soil has a large amount of nitrogen which has come from the decomposition of protein and other nitrogenous substances which, in breaking down, put nitrogen into the soil. The nitrogen is taken up by plants, and this plant nitrogen or protein may be taken directly into the human system or may be taken up by animals and as animal protein into the human system. The last step is the use of the protein to build up muscle or tissue. The cycle then begins anew.

In the oxygen cycle, oxygen is taken from the air by the human body and is given off in the form of carbon dioxide. The latter is taken up by plants. The unused oxygen is given off again. This carbon dioxide, the refuse from the respiration of animals, is the main constituent of air that is utilized by plants.

Composition of Air. Air is a mixture of gases, of which oxygen and nitrogen are the most important. The air contains from twenty to twenty-one per cent of oxygen, while nitrogen makes up most of the remainder. The usual amount of carbon dioxide is only three parts in 10,000, so that the amount of this gas, about which we have heard so much, in ordinary air is actually very small.

The difference in percentages between inspired and expired air is shown by the following table:

	Oxygen	Nitrogen	Carbon Dioxide
Inspired air	20.81	79.15	0.03
Expired air	16.033	79.557	4.38

The expired air is, of course, warmer than the inspired, contains more moisture, but fewer particles of dust, and, under the conditions of ordinary respiration in health, no bacteria.

Oxygen is the element of the air which sustains life. We inhale about seven pounds per day and about two pounds of this are absorbed by the body. When the oxygen in the air decreases to only eleven or twelve per cent, the air becomes dangerous, and, when the oxygen reaches seven per cent, death results from asphyxiation. Even in the worst ventilated rooms the oxygen is rarely much lowered and asphyxiation practically only takes place when some other gas is substituted for air.

Asphyxiation may be caused by the inhaling of illuminating gas, but, in this case, death is usually due to the poison carbon monoxide. In war death has been caused by chlorine gas, which is heavy and rolls along the ground, displacing the air. The victim strangles to death as in drowning. There is, of course, the irritant and the poisonous effect of the gas itself, for chlorine is extremely irritating to the lungs. Other extraneous gases may poison the organism without causing irritation or mechanical suffocation.

The nitrogen in the air merely serves as a diluent of the oxygen and thus regulates the rate of combustion. The animal mechanism uses it in no way.

Humidity. Moisture is an ever-present factor in the air, for moisture is given off by everything which breathes. An adult person gives off about four pounds of watery vapor every twenty-four hours, two and a half pounds through the skin and one and a half pounds through breathing. Growing plants and trees also throw off an immense amount of moisture. The presence of this water or moisture in the air — the condition known as humidity — has a considerable

effect upon health. The proper amount of humidity is from fifty to fifty-five per cent of the amount of moisture which the air can take up at that temperature. An increase of 27° F. of temperature doubles the capacity of the atmosphere to take up moisture. The precipitation of dew is a familiar illustration of the inability of cold air to retain as much moisture as warm air.

As we all know from experience, humidity increases the effect of heat and cold on the body. On hot days when the humidity is high — "muggy days" — the heat is unusually oppressive. Places near the sea or water areas are apt to have a high humidity, and, in hot seasons, the inhabitants suffer greatly with the heat and, in cold seasons, the effect of the cold is intensified. In deserts and other dry areas with a low humidity, temperatures of 110° F. are not so uncomfortable as a temperature of 85° with a high humidity.

This question of moisture in the air is of vital importance in the heating of our houses. In artificially heated houses the humidity is generally too low, for the house can be kept at a lower and more comfortable temperature if the amount of moisture is increased. In addition, the individual is much better off if there is a certain amount of moisture in the air. Before the air can go to the lungs, it must be properly moistened, as well as heated, by the nose and throat. Many of the colds which occur in winter find their origin in the dry heat of rooms without any moisture, which keeps the nose and throat irritated and, therefore, liable to infection.

If moisture is to be artificially added to the air, it should be to the warm air and not to the cold air, for cold air saturated with moisture will show a low humidity when the air becomes warm. Most of our systems of heating make no allowance for supplying moisture.

Several devices to accomplish this purpose have been attempted, but none of them has been sufficiently perfected for general use in small houses. A simple method of improving the humidity is by placing a pan of water on the radiator. Another effective method is by keeping plants and flowers in our rooms, for they always contain and exhale a considerable supply of moisture.

Dust. Dust, or suspended dry particles, is another substance which is always present in the air. If there were no dust whatever, there would be no rain, no fog, and no clouds. The moisture of the air is taken up by the suspended particles of dust, and, if these particles were not present, there would be precipitated moisture over everything. This dust is made up of many kinds of animal and vegetable matter, but the important elements, from the viewpoint of hygiene, are the collections of bacteria and the so-called droplets which are borne about in the air. These droplets are active factors in the spread of disease. When a person coughs or sneezes, moisture and droplets are thrown off and by these small droplets bacteria are carried to other people. This is the so-called droplet method of infection.

Dust should be controlled as much as possible, if for no other reason than to prevent the irritation of the air passages. All dusting in the house should be done with moist cloths or with a vacuum cleaner which actually removes the dirt. Streets should also be cleaned in a way which will not create dust.

Sewer Gas. No discussion of the air is complete without reference to sewer gas. Thirty or more years ago, before we knew anything about bacteriology, sewer gas was supposed to cause many of the human ills. Even to-day this superstition has not entirely disappeared. Sewer gas is decidedly unpleasant to

the smell, but it probably carries no more organisms than ordinary air, and, like ordinary air, is dangerous only on account of the bacteria. Of itself sewer gas is harmless; it is simply a bad odor. The effect of odors or bad smells on health is not, it must be admitted, well understood. Unpleasant odors diminish the amount of air inhaled, while pleasant odors usually cause us to take deeper breaths. All air has various odors which are detected and differentiated by the lower animals. Through civilization, however, our sense of smell has decreased in acuteness, and we become rapidly accustomed to any unusual odor.

Ozone. Ozone is another constituent of the air, but, so far as we know, it is of little moment. In concentrated form ozone kills bacteria and is an irritant to the body, but it is not present in the air in sufficient quantities to have any effect either one way or the other.

Atmospheric Pressure. Atmospheric pressure is an important consideration in hygiene. At sea level a man of average size is subjected to about fifteen tons of atmospheric pressure and all the bodily functions are adjusted to this pressure which itself is probably a considerable factor in the operation of many of them. The fact that people have considerable difficulty in breathing on the tops of mountains is familiar, and this difficulty is caused by the change in pressure of the atmosphere. Atmospheric pressure is like any other form of pressure — it represents a certain amount of weight. When a man climbs a mountain, simply because he has less miles of atmosphere weighing down on him, the amount of pressure is less. Then hemorrhages may occur, because the blood is accustomed to being held back by a greater pressure. Nothing can be done to prevent this condition and, as a rule, accommodation soon occurs. The difficulty in breathing is in

getting the proper amount of oxygen. Our systems are tuned up to the extraction of a certain amount of oxygen at a given pressure. If the air pressure is diminished, the extraction of oxygen is more difficult and we have to breathe more rapidly to get the same amount of oxygen.

In passing through a tunnel one may experience a certain amount of headache, due to the increased amount of atmospheric pressure. This pressure may even cause actual sickness. Men who work under increased atmospheric pressure are subject to "caisson disease." The treatment of this disease is to bring the sufferer back into ordinary air pressure, gradually and not too fast. If the pressure is slowly increased by passing through several chambers with increasing pressures and as slowly released, the workers usually, but not always, avoid the ill effects of the increased air pressure.

Air as a Cooling Agent. Air is used for two principal purposes, — breathing and for cooling purposes. The old view which was held concerning air was that such things as sewer gas and carbon dioxide were of great moment in the so-called "bad air." As a matter of fact the effects of bad air are due, primarily, to the interference of the cooling of the body by the air. Men have been put into places where the air was bad and foul and, as they felt injurious effects, it was decided that these effects were due to the inspiration of poisonous gases. But experiments have been made in which the body remained in the bad air and the nose out of a window. The bad effects continued. The conclusion from this is that the bad effects were due to the interference with the cooling of the human machine by air. Bad air is hot and moist both from the breathing and from contact with the human body. This moist heat interferes with the cooling of the body.

While the bad effects of crowded rooms are largely due to the interference with the cooling of the body, the presence of large numbers of bacteria in the air makes infection easily possible. Disagreeable odors add to the discomfort. No matter how much air is breathed and re-breathed in such a place, the amount of oxygen is not reduced materially. In mines oxygen may be reduced, but in buildings the amount of oxygen remains constant.

The amount of air which the body requires is about 3,000 cubic feet per hour. The problem of ventilation is to give this amount of pure air, moving, and with the proper amount of moisture. If the air is still, the body becomes surrounded by a warm, moist envelope which causes over-heating. Moving air equalizes the temperature and the moisture. Our own feelings are the best registers of the freshness or badness of air. We are certain that the amount of carbon dioxide will never be sufficient to cause asphyxiation, but the estimation of the carbon dioxide content of air gives accurate information as to how well the air is changed and it is, therefore, of considerable importance.

Climate. We hear a great deal about the effects of climate on health, but, in reality, we know little about climate. Without a doubt many people are benefited by warmth and sunlight, but this may well be as much a mental as a physical benefit. Climate indirectly affects the health by making people feel better through being out-of-doors. But this is the effect upon the temperament rather than any wonderful thing in the air. On the other hand, there is a certain amount of evidence that people with some diseases do better in particular climates. For years consumptives have gone to Colorado and regained their health; other consumptives have done the same at home. Still the consumptive seems to do better in the high, dry air, which is,

perhaps, due to the physical effect of a low atmospheric pressure and a low humidity. Just how these conditions act we do not know.

The ills attributed to climate are often due to bacteria and parasites. Tropical countries have been considered unhealthy on account of the presence of malaria and yellow fever, but these diseases are due solely to the presence of mosquitoes which carry the diseases. Swampy air does not cause malaria, but the bite of a malaria-infected mosquito that lives in the swamp is the causative agent. A certain relation does seem to exist, however, between the physical factor of increased humidity and certain rheumatic conditions.

Another superstition in regard to air is that night air is injurious. The only difference between night air and day air is that night air lacks sunlight. The chemical difference between any airs is practically nil. Thus in out-of-door sleeping the benefit derived is not due to the difference in the air, but to the tonic effects of the colder air outside. The beneficial effect of this cold air has been demonstrated in the treatment of various diseases. But in such treatment the effect of sunlight on the body, as yet undetermined, must not be underestimated and this action is entirely independent of the air.

Deep Breathing. We commonly think that we are filling our lungs with fresh air at each breath. Such is not the case, for we never get our lungs filled with fresh air. What we do is to ventilate a long tube which has no interchange whatever with the blood. Most of the time our lungs are filled with bad air, and we simply exchange a part of it for fresh air. Thus, if a person breathes rapidly, he is doing a great amount of work which is practically useless, for slow breathing is the more economical method. Deep breathing is undoubtedly extremely beneficial. Most of us, due

to the fact that Nature leaves a considerable margin of safety, are able to carry on our ordinary activities without the requisite ventilation of the lungs, especially if we do not exercise. This is injurious to the lungs for it allows the blood to stagnate in them. Exercise is Nature's method of compelling ventilation in the lung area. Deep breathing may be used as a substitute, but the other beneficial effects of exercise are lost.

Drafts. Although moving air is necessary for well-being, when air becomes so violent in movement that we are conscious of it we call it a draft in the house and a breeze outside and consider the condition somewhat dangerous to health. Once and for all drafts do not cause colds. Bacteria, and bacteria alone, are the cause. However, if one part of the body is cool while the rest is warm, as in the case of a draft, or if the entire body is allowed to be cooled suddenly and continuously, as in a breeze, the whole heat-regulating apparatus of the body is upset and this may predispose to colds. But in the absence of the cold-causing bacteria, no exposure to drafts and no chilling will cause a cold.

Conclusion. The importance of air is two-fold: as a carrier of oxygen and as a cooling apparatus. The ill-effects of "bad air" are apparently largely due to the inability of bad, stagnant air to cool the body. In breathing bad air the main danger seems to be the increased danger of infection.

CHAPTER IV

The Skin

Functions of the Skin. The skin and the various glands connected with it form a complex organism with functions of great importance in the work which the body has to do. These functions may be classified as protective, sensory, respiratory, heat-regulating, and secretory. The skin protects the body from injuries from without and also acts as a guard against a too rapid loss of the liquids and heat from within. Thus the skin protects the muscles, nerves, and blood vessels from such dangers as might be caused by blows or pressure, as well as from the injurious effects of high and low temperatures. As the skin forms a sensory covering to the body, it conveys the sensations of pressure, temperature, and pain so that the body may adapt itself to changes in its environment. The skin aids the lungs in their work of respiration and, like the lungs, throws off water and carbon dioxide, and absorbs oxygen. The respiratory work done by the skin, however, is only a minute fraction of that which the lungs do.

The heat-regulating function of the skin is its most important work. In this the skin is aided by the two million or more sweat-glands which are distributed over almost the entire surface of the body. The skin and the sweat-glands together serve to keep the blood at an even temperature, either by giving off heat or in preventing this process in case the outside air is too cool. The body temperature is, as a rule, higher than

that of the outside air so that heat is generally being given off by the skin. We are perspiring constantly, but usually to such a slight extent that we hardly notice the fact. The amount of heat which is thrown off at any time is proportional to the amount of the body surface. Through exercise the amount of heat is increased and sweat is produced and given off. Thus sweating is merely another method of getting rid of heat. The body becomes too hot, either through an increased burning of food and tissue within, or because of increased heat outside. In either case sweat is produced and collects on the skin. It is estimated that fifteen per cent of the total heat of the body is given off through the skin, and ten per cent by the lungs.

The condition of the air influences the amount of work which the sweat-glands do and the amount of perspiration thrown off. If the air is full of moisture, the perspiration does not evaporate and the heat becomes excessive. If the air is dry, the perspiration evaporates rapidly and the body is cooled. Over one liter, or one quart, of perspiration is thrown off by the skin every twenty-four hours. While the skin and its glands keep the heat of the body well regulated, the changes of climate are so great that animals are provided with hair for further protection against the changes in temperature. On the other hand, man uses clothes for this purpose. Perspiration may be caused by other things than by heat and exercise. The nervous system is an important factor, as the "cold sweat" of fright shows.

The sweat and sebaceous glands are the secretory glands of the skin, which secrete the water and fats that the skin needs very badly to keep it lubricated and in a working condition. This fat or grease is furnished by the sebaceous glands. If a person has greasy hair, it means that the sebaceous glands of the hair have an

over-secretion of grease. These glands form an additional layer of fat on the surface of the skin, and the oily substance from them protects the skin from losing a large quantity of heat.

The proper hygiene of the skin depends upon a wise selection of food, a proper amount of exercise, careful attention to bathing, and suitable clothing. The functions of the skin may be impeded by neglect of any of these essentials, but absolute cleanliness is, perhaps, the most imperative of all.

Clothing. The matter of clothes is not one of vital moment in the care of the health. Clothes were not originally intended for the purpose of keeping warm, but rather to increase the sexual attractiveness of the individual. As we have become civilized, however, we have lost sight of the original idea of clothes, and they are now worn as a matter of decency and to keep the body warm.

As an important function of air is to act as a cooling apparatus, clothes should never interfere with this. Clothes should be sufficiently loose to allow a reasonable circulation of air around the body. This means that the air should have free access to the skin, and that all outer clothes should be loose and porous. Tight clothes interfere with the normal functions of the parts of the body which they cover. We are coming to realize more and more the benefits of wearing as few clothes as possible, and only the minimum amount that will secure warmth should be worn.

In selecting clothing to be worn for the preservation of heat, it should be remembered that certain colors attract, while others reflect heat. Black absorbs heat to the greatest extent, and white the least. The more nearly white the clothes the better.

Wool makes the most desirable articles of clothing, for it is not only warm but it also absorbs moisture, —

an important point. But as woolen cloth does not give off moisture rapidly, it is undesirable for underclothing, as the retained perspiration works to the disadvantage of the skin. Cotton cloth is preferable during hot weather, as it does not keep the body warm, and, being thin, allows a proper circulation of air. All animal coverings are warm, due to the fact that in addition to the highly impervious skin layer there is also considerable air in the mesh of the coat. The same result may be obtained with layers of paper, for with the air spaces between the layers, there is little conduction of heat.

It is perhaps unnecessary to add that clothing should be kept clean and well aired. Damp clothing aids the growth of micro-organisms and, helped by the heat of the body, favors the development of parasitic skin diseases.

Bathing. The presence of perspiration and grease from the glands makes it imperative that the skin be cleaned carefully in order that it may freely perform its functions. The relation of baths to health is a curious one, for we cannot say that baths are absolutely essential to health. To a certain extent it is true that bathing is largely for cosmetic purposes and only indirectly for purposes of hygiene. The hands, the face, and finger nails, however, must be washed with care, especially before meals and before food is prepared. This rids the surface of the skin of any kind of infection which may be present. Neglect of such precautions is responsible for the spread of various bacterial and parasitic diseases. Soap dissolves the products of the glands, which may remain on the skin and which may prevent their doing their proper work.

A cold bath has a stimulating effect on the body. It sends the blood to the skin, increases the heart action, warms the body, and gives a good circulation of blood

throughout the body. This means that the cold bath has stimulated the metabolism of the body in every way. But the value of the cold bath should not be over-emphasized — it is simply a method of stimulation. If the cold bath is too prolonged or too cold, the body is chilled and the heat-regulating mechanism is disturbed with possible bad effects. Some persons are easily affected by cold baths, — their systems do not react, so that cold baths are harmful to them.

A warm bath, on the contrary, acts as a sedative. It is slightly warmer than the body and so relieves the work of the body for a time. The most important thing about all baths is the securing of personal cleanliness, which is best obtained by the use of hot water and soap. It should be remembered, however, that a prolonged hot bath which disturbes the heat-regulating mechanism is harmful.

Under ordinary conditions the skin remains smooth and requires little real attention. The natural moisture and oil provided by the glands keep it lubricated and soft. Still the skin may be disturbed in a number of ways. One is by mechanical conditions such as heat and cold. Burns illustrate the effect of too great heat, while the effects of cold run all the way from chapped hands to the freezing of different parts of the body.

The Skin and Diet. There is considerable controversy over the effect of diet upon the skin, but there is no question that it has a certain influence. When people take an insufficient amount of water, the skin becomes too dry. Then in the case of an abnormal skin diet plays a considerable part. The classical example is the satiny skin, the pimples, and the red nose as the result of alcoholic excess. Such effects, however, should be regarded as the result of the use of a poison. Drugs, which should always be regarded

as poisons, cause skin trouble. Among such drugs are potassium iodide and potassium bromide. Even quinine may cause a skin rash. Furthermore, it is known that constipation causes a muddy skin or acne.

We may also take in certain poisons in our food, which cause skin trouble. In the case of anaphylaxis, where certain individuals are susceptible to definite kinds of food, one of the evidences of the poison is the rash known as the hives. Of course the avoidance of that kind of food is the treatment in such a case.

Disturbances of the Skin. Pimples, or acne, is caused by a disorder of the sebaceous glands. Usually there is first an overactivity of the glands, and, subsequently, some infection of them. The evidence of this disease is the familiar greasy, dull brownish skin, with pimples, blackheads, and pustules. It is especially striking that acne is prevalent just at the time or just after the time of reaching puberty. This is due to the increased activity and growth of the hair on the body and face at that period of growth. With the development of hair follicles comes the development of the sebaceous glands, but in young women the sebaceous glands of the face may become overactive without an increase of hair. This abnormal activity or restlessness of the skin is greatly increased by poor habits of hygiene. Probably much of this trouble comes through a badly regulated diet. At any rate people are aware that so long as they keep in good condition and take good care of themselves there is little likelihood of acne. In other words, ordinary hygiene, a reasonable diet, regular meals, regular hours, and the scrupulous care of the bowels, is the best prevention and cure of acne. Local applications under medical supervision are, of course, of great value.

Eczema causes approximately one-fifth of all the skin troubles. This condition of the skin is also

known as salt rheum, and is characterized by a variety of appearances, perhaps most commonly by red, weeping surfaces, itchy, red pimples, and rough, thickened areas. We are ignorant of the exact cause of the disease and, consequently, there is no particular prevention. At present eczema is ascribed by some authorities to an inability to digest certain kinds of foods, which thus produce substances that come to the skin and irritate from within. It is probable that in some cases eczema has an association with the external irritation of the skin, and so care should be taken to protect the skin from scratching and other irritations. The treatment of eczema varies in different cases and should be placed under the care of a physician at the first appearance of the disease. Early treatment is imperative, for, in this stage, the disease yields readily, but, if it becomes deep-seated, it may be very difficult to eradicate.

Associated with the sebaceous activity in acne, is another condition known as dandruff, and allied with that the condition known as baldness. Heredity plays a large part in producing baldness, and in certain families baldness occurs almost inevitably at an early age despite any and all treatment. This is probably due to the fact that the vigor of the hair dies out. Baldness is also caused by dandruff and a poor condition of the scalp. It is hardly necessary to say that the hair and head should be kept clean, but continual shampooing does more harm than good except in a few isolated cases. It is a safe rule never to put on the scalp anything but the simplest things, and shampooing at intervals of two or three weeks is usually sufficient to keep the hair in good condition.

In certain families there is a tendency for the hair to turn gray or white at an early age. There is practically nothing that can be done to prevent this. Hair dyes should never be used. In case lead hair dyes are used

there is an excellent chance of contracting lead poisoning, and, in any event, nearly all hair dyes injure the hair and irritate the scalp.

Other inflammatory conditions of the skin — the various forms of dermatitis — are well known to everyone. The inflammation caused by poison ivy is a familiar form of dermatitis. Most people are susceptible to this poison, but certain individuals are more likely to be affected seriously than others. One attack of ivy poisoning seems to add to the susceptibility. The fuzz of brown-tail moths also causes an uncomfortable form of itching dermatitis. Furs which have been kept in preservatives also cause irritation, but this can be prevented by keeping the furs clean.

A number of the disturbances of the skin are contagious. A common infection is the wart, although we do not know how the infection is carried nor what the cause may be. There have even been epidemics of warts in various schools. Numerous superstitions have arisen concerning warts — the lore of every boy and girl — due to the fact that warts disappear suddenly and with no apparent reason. There is no way to prevent warts except the ordinary prevention of any infection, — cleanliness. It is not always wise to have warts cut off or burned away with acid, for Nature will usually take care of them and then no unsightly scar remains.

"Red flap" is an infection of the skin that is especially common on the athletic field. This starts between the legs or under the arm-pits as a seeming irritation. This is really an infection by a certain mold. Once started the contagion, which is easily carried by such articles as towels, may spread to all members of the athletic team. As it is contagious, it should be treated like any other contagion, that is by

segregation of the individual sufferer. The prevention is by scrupulous cleanliness of body and clothes, and cleanly habits in the use of towels.

Boils, another form of skin infection, are caused by a definite bacterium, the staphylococcus aureus. This is a pus-forming bacterium which occurs widely and often lurks on the surface of the skin. Once the bacterium gets into the skin it may be difficult to dislodge. Boils occur commonly on the back of the neck and there is a definite reason for this. The rubbing of the collar starts the trouble; then the germ gets into the skin, and a pimple is formed. If this pimple is irritated, the germs are spread still further, and a boil is formed. If the sufferer is particuarly unlucky, a carbuncle may result. The spreading of boils is extremely easy, but it is, nevertheless, due to gross carelessness. There is, of course, a degree of individual susceptibility. The avoidance of boils is simply a matter of strict personal hygiene and cleanliness, as well as the recognition of the fact that the germs may be spread all over the body and transmitted to others. The most frequent method of transmission of the germs is by the hands, and the conclusion here is the obvious one of scrupulous personal hygiene. Boils are a typical example of a skin infection which comes from a germ and finds an opening through an irritation of the skin.

The " seven years itch " or scabies is another example of skin infection for which personal cleanliness is the only preventive. This condition causes much annoyance if it is not treated both immediately and drastically. It is popularly supposed that the " seven years itch " is a condition which does not occur in the higher conditions of society, but such is not the case. It is caused by a small animal parasite that burrows in the skin. That this itch spreads easily from person to

person is shown by the tremendous prevalence of scabies in the armies of France during 1914 when bathing facilities were deficient.

Other animal parasites, such as lice, which cause skin lesions, and other molds, such as ringworm, can be avoided by ordinary habits of cleanliness. Such personal cleanliness should include not only contact with other human beings, but also with the lower animals, for ringworm is often spread by the domestic animals. The treatment of these conditions is a matter for medical advice in each instance.

CHAPTER V

Exercise and Work

The Function of Exercise. Physical work begins at birth, and, in various ways, continues on through life. The child plays, the youth indulges in sports, and the adult works. While a large amount of physical work is done even when a person is at rest, the heart is two or three times as active under conditions of extreme physical activity. We are all familiar with the fact that when we take a great deal of physical exercise we feel hot, and thus the generation of heat is one of the effects of such work. We sometimes attempt to keep warm by physical activity, but only ten per cent of the heat of the body is generated in this way. Most of our food goes to make heat and to create motion, eighty per cent being used in the heat-forming process. This is the reason why a man who leads a sedentary life will require and eat almost as much food as one who leads a very active life.

Muscular activity as play or work increases the functions of the body. More blood comes to the skin and more blood goes away from the skin during exercise. More waste products are thrown off, as well as more heat. The same thing applies to every part of the body. The brain, for instance, gets more blood during physical activity and the waste products are much better removed. The effects of exercise, however, are particularly evident in the lungs. Rapid breathing means that the blood is circulating around at a much greater

rate of speed and thus more fresh air is brought to the lungs and the waste products driven off. As a result during hard work there is a beneficial change in the lungs and in the heart as well.

It is difficult to estimate the amount of work which it is desirable for a person to do, but a certain amount of physical exercise is absolutely necessary to keep the organs of the body in good condition. A fair day's work for the adult man may be represented by 300 foot tons; a hard day's work by 400 foot tons, and a very hard day's work by 500 foot tons. The last, 500 foot tons, is the amount of work a soldier would perform by marching twenty miles a day at three miles an hour on a level road. The amount of work would be increased, if the speed were greater. A man weighing 175 pounds, carrying twenty-five pounds up six flights of stairs (90 feet) would do eight foot tons of work. All these estimates, of course, are entirely theoretical. The amount of work necessary to keep the man of sedentary habits in good condition is about 100 to 150 foot tons.

The problem which concerns mental workers is not that of the day laborer, for the latter gets sufficient exercise in his work. The problem of the mental worker is to get sufficient physical exercise, usually as recreation, to keep the mind and body at its maximum efficiency in addition to doing his ordinary work. This problem gets more and more acute as he gets older. The normal child gets sufficient amount of exercise in his play, and his apparently perpetual motion is a perfectly normal thing. As he grows, the main purpose of sports is to furnish the requisite amount of exercise which is necessary for the well-being of any individual. Soon, there is apt to be a sharp division between the athlete and the non-athlete and this division becomes more and more marked with a tend-

ency for all to take too little exercise. It is a fallacy to think that sufficient exercise can be taken once a week, or once a month, or once a year. In order to be efficient exercise must be regular and at relatively short intervals.

All exercise should tend towards using all of the muscles of the body. But just as muscular exercise increases the blood supply to the brain and facilitates the removal of the waste products, so exercise of one group of muscles to a certain extent benefits all. If all the muscles are exercised, however, the body tends to become more symmetrical and, in the second place, it is much better for the muscles. Walking is the favorite form of exercise, and from walking or running one gets beneficial results throughout the body.

Another question arises in regard to exercise, — the matter of indoor or outdoor work or play. On the Continent the people favor indoor recreation, and in certain countries it may be said to be the national method of taking exercise. In this country, on the contrary, we are attached to outdoor games and sports. The condition of the air is too often a serious objection to gymnasium work. Another objection is the monotonous character of most of it, as it lacks any recreative features at all. The beneficial results of exercise are greatly increased if the person enjoys the work or play. Competition, within reasonable limits, adds to the advantages of exercise, largely on account of the increased pleasure and the training of the mind and nerves.

Monotony is an important factor in the causation of fatigue, and all recreative exercise, therefore, should avoid monotony. Every new form of exercise or work, however, relieves the monotony. The letter carrier, for instance, may find sufficient variety in riding a bicycle during his respites from walking, although such

a slight change in form of exercise can hardly be enthusiastically recommended. The factor of fun and the variety of recreative exercise are probably of more importance than the mere muscular activity, and they illustrate why games are preferred to chest weights.

The nervous system, rather than the muscular system, gives out when exercise is too prolonged or too vigorous. But the nervous system can be made stronger through training. In fatigue, for instance, a person has lost control over his muscles. The process of getting into condition, therefore, is directed more towards strengthening the nervous system in its control over the muscles rather than in increasing sheer muscular strength.

In overtraining, of which we hear so much in connection with athletic contests, it is the nervous system which gives out. The athlete's muscles and strength are the same after becoming overtrained as before. What he has lost is the quick and perfect control over his muscles and strength. Thus overtraining is a mental and nervous phenomenon and should be treated as such. The overtrained man must refresh his nervous system, and, if he is really overtrained, he probably cannot " get back into shape " for the entire season of his special sport, that is within a few months.

In connection with athletics we hear a great deal about the so-called athletic heart. It is true that at times of hard exercise, a great deal of work is thrown upon the heart, but Nature has left a large margin of safety. The heart will respond to much beyond the accustomed demands without injury. It is possible, however, for a person who is in a flabby condition and who has done little physical exercise to exert himself to such an extent that the heart, entirely unaccustomed to such demands, may stretch. If a man is well trained, it is practically impossible for him permanently to

damage his heart. Nature is kind to the body. Just when a person is going to injure himself by overexertion, he faints or "passes out," and thus it is impossible for him to do any more physical work.

Rowing has probably been more frequently accused of damaging the heart than any other sport, yet in examinations made by the writer on men who have rowed and men who have not, no evidence has been discovered that, under a proper system of training, any damage is done to the heart. The heart of the man who had rowed for ten years was found by the most careful clinical and X-ray test to be practically no larger than the heart of the man who had not rowed at all. All the evidence seems to indicate that the term "athletic heart" should be viewed with grave scepticism. Sir James MacKenzie, an eminent English authority on diseases of the heart, concludes: "I have seen a very large number of youths who were supposed to be unfit to play games or to row because of some impairment of the heart. Except in a few instances of manifest heart disease, the evidence on which the heart's impairment was based was those manifestations of murmurs or irregularity which my experience has shown to be perfectly consistent with a healthy heart."

With our modern methods of precision it seems apparent that many of the criteria upon which diagnoses of the athletic heart were made were false. It is extremely doubtful if a man can hurt himself physically by so-called excessive exercise, although he may injure himself as far as his nervous system goes. In this connection it is worthy of note that a recent Harvard athlete, who made his letter in three sports and was remarkably proficient in all and who, in addition, held the college strength record, had a heart of less than the average size. Statistics on the relative

longevity of athletes and non-athletes are somewhat conflicting. The data at hand indicate strongly that participation in strenuous competitive athletics does not shorten life and that premature death in athletes is to be attributed to the same factors which cause premature death in the non-athlete.

There is a habit in regard to exercise, just as there is a habit in regard to everything else. Many athletes stop all forms of exercise as soon as they leave college. This is extremely unwise. It is not to be wondered at that the bodily mechanism geared up to a high state of activity rebels and chafes at a sudden change to inactivity. It is equally unwise for the man who has been taking no exercise to go out and exercise a great deal. When habits are being changed, they should be changed gradually, in such a way that the entire body may not be upset.

Exercise bears an important relation to the weight of the body. If an individual is overweight, exercise will take off fat. On the other hand, the beneficial effects of exercise are such that the blood goes to all parts of the body and more waste is taken away so that people who are underweight will actually gain in weight. As a matter of fact people who are normally active physically tend to approach the normal standards of weight.

Some of the evils of the lack of exercise are familiar to everyone. In contrast to the fresh complexion and clear eyes of the man who is "in trim" are the poor color and sallow complexion of the man who takes no exercise. Lack of exercise brings as one punishment constipation and as a second obesity, unless the food intake is cut down to the low requirements of the sedentary life.

The proper amount of exercise to take and particularly the minimum amount of exercise which one should

take depends a great deal on the individual. An attainable minimum for the average adult person might well consist of taking simple exercises in his room and to get out-of-doors once a day and walk rapidly for at least half an hour. In addition, it is desirable for any one up to fifty years of age to take some kind of moderately violent exercise at least once a week. This should be sufficiently strenuous to induce perspiration. This is important for several reasons. In the first place, there is an old saying, which happens to be true, "never let your blood vessels get stiff." In addition we should call on the tremendous reserve which Nature gives to us at least once in a while. It makes little difference what kind of exercise we take, so long as we do it regularly.

Fatigue. While exercise is beneficial, there are certain evil effects of excessive exercise and excessive work. As in the case of the first Marathon runner, it is possible to cause immediate death by overexertion, but such instances are extremely rare. The effects of overwork or overexercise, that is excessive fatigue, are essentially chronic in character and remote in point of time. Since the penalties are deferred, it is often possible to continue the fatigue-producing activities and to permit the accumulation of fatigue and, consequently, the accumulation of the penalties.

The effect of physical work has been carefully measured in the physiological laboratories where the results of work, and especially the result of very violent work, can be shown in the blood. Certain poisons are given off by the muscles in activity which are carried around by the blood, so that we feel fatigue. Fatigue is Nature's warning and we should heed that warning by taking a rest. If violent work is continued, the blood is completely filled with the poisons of fatigue. These poisons go to all parts of the body and particu-

larly to the nervous system and the brain. That the blood contains this poison of fatigue is shown by experiments on dogs. A dog is fatigued by exhaustive muscular work. Then if the blood of the tired dog is largely exchanged with the blood of a fresh dog, the tired dog becomes the fresh dog and the fresh dog tired, although he has done no work. Similar experiments have been carried out on separate muscles.

Experiments on carrier pigeons have shown that, after a long flight, there are marked changes in the brain cells. Thus it seems that the trouble caused by fatigue is in the brain cells and in the nervous system. While this problem of fatigue has not been definitely settled, it seems likely that the evil effects of fatigue are much more in the nervous system than in the muscles themselves. Thus, as has been known for a long time, work or exercise will "take more out" of the individual when he is fatigued than when he is rested.

These principles concerning fatigue should be applied to our everyday life. We should not, for example, exercise up to the point of fatigue, nor when fatigued. Neither should we take exercise immediately after eating. The fact that a stomach is upset after a race or after violent exercise is simply another evidence of fatigue and its results.

Fatigue plays a considerable part in the work of daily life. This subject has only received careful consideration within recent years. The first mutterings on the relation of fatigue to industry came in England about 1816, when, as the result of the influence of medical testimony, laws were made restricting the hours of labor in certain trades. But practically all our knowledge about fatigue comes from a later date. In 1907 a Royal Canadian Commission was appointed to investigate the conditions governing

the work of the telephone workers in Toronto and the report of this commission made a tremendous impression on the industrial world. It is obvious that many other factors besides the actual work itself demanded consideration in an employment so complicated as this. Speed, responsibility, complexity of the work, monotony, as well as the factor of noise and confusion, were shown to have their share in the production of fatigue. These complicated factors obviously involve the nervous system from their very nature. The operators were found to suffer from specific injuries to the special senses the use of which was continuously required, but the chief injury to the health was shown to come from nervous exhaustion. As a result of its investigations, the Royal Commission found that seven hour's work as a telephone operator scattered over nine hours was a sufficiently long working day for women employed in this nerve-racking industry. The schedule was framed on a basis of good working conditions and involved a schedule of two hours' work, one half hour's relief, one and one half hours' work, one hour intermission, two hours' work, one half hour's relief, and one and one half hours' work.

Immediately after the appearance of this Canadian report, valuable statistics from Germany came to light, which showed that shorter hours instead of decreasing the output rather tended to increase it. The effect of the appearance of this evidence tended to offset some of the consternation among employers which had been caused by the previous report. The Zeiss Lens Company, of Jena, Germany, in 1870 had a twelve-hour day which was reduced from time to time on humanitarian grounds. In 1900, when the working hours had reached the eight-hour level, it was found that the men actually did much more and better work than under a nine-hour day. Abbé, who investigated

the conditions in the Zeiss plant, also proved that one day off in seven increased the amount of work done and decreased the amount of fatigue. His conclusions were that the eight-hour day benefited both the employer and the employe. Workers during the first year of the eight-hour day did an average of ten days' more work than under the nine-hour system. Instinctively the workers seemed to increase their intensity of application, and in place of being constantly subject to lack of efficiency through an accumulation of the effects of fatigue, they were always able to work at their best.

There is a considerable temptation to make broad generalizations concerning fatigue and efficiency, but many factors complicate the deductions. The engineer of a fast express has a tremendous strain and a consequent amount of fatigue. He is able to work at this tension for a few hours and may even be better for a day's rest between runs. The engineer of a slow freight may be able to work, let us say, eight hours a day, without damage either present or future. The deciding factors of fatigue arising from work are the factors of speed, responsibility, complexity, monotony, confusion, and noise, rather than the foot pounds of actual work done. Purely creative mental work, although requiring no output of physical energy, is, perhaps, the most productive of fatigue. The output of genius will not be increased or decreased by an eight-hour or a five-hour workday. So every job must, in a sense, be a law unto itself. From the medical viewpoint, the highest efficiency in output and health in the average job probably demands not more than an eight-hour day for men. It is very doubtful whether the average woman can retain her health (present and future) and her efficiency, and work eight hours a day in the average job for women under average conditions in the

shop or factory. Women who are actually bearing children need rest as well as nourishment for two instead of one, and their hours of work should be regulated accordingly. Children, who use up much energy in growing and whose nervous systems are more delicate and unstable than those of adults, should do less work than women. Children under fourteen, and probably under sixteen, should have no regular place in the industrial world. Child labor means arrested development, physical and mental, and chronic fatigue, with its attendant ills, of the future parents of the race.

It is unfortunate but true that we have no adequate tests for determining the ability of a given individual to undertake a given task without damage. Here again we are brought face to face with only general considerations. The average man can do more than the average woman, who, in turn, can do more than the average child. A robust person will probably be less affected by hard work than a delicate-appearing person. But that is all. The more subtle differences in persons, which enable one to accomplish with ease and without fatigue, certain tasks that are impossible for another, are not yet measurable. What we have learned has been from the accumulative evidence of the bitter experience of the years of labor of many people.

As people have different degrees of resistance to fatigue, so fatigue affects different people differently. It affects an individual in his so-called weak spots. That is, a person who has overworked or become fatigued may find that he has a headache, a backache, or trouble with his eyes. The chances are that he has always had this trouble but the fatigue has aggravated it and brought it to light.

Fatigue and Accidents. The fact that fatigue has a marked relation to accidents and disease is of the utmost importance in considering this subject, both

from the standpoint of industry and from that of everyday life. The majority of accidents in industry happen late in the day when workers are tired. It is when a man is tired that he does not get his hand out of the way of a mutilating machine which he may have been running for days, weeks, months, or even years.

The following German statistics show the number and per cent of accidents during one year, by hour of the day:

Accidents			Accidents		
Hours Morning	Number	Per cent	Hours	Number	Per cent
6 to 7	435	2.82	12 to 1	587	3.81
7 to 8	794	5.16	1 to 2	745	4.84
8 to 9	815	5.29	2 to 3	1037	6.73
9 to 10	1069	6.94	3 to 4	1243	8.07
10 to 11	1598	10.37	4 to 5	1178	7.65
11 to 12	1590	10.31	5 to 6	1306	8.48

The conclusion from these figures is that fatigue is responsible for a large proportion of the accidents in the industrial world and that, as is generally recognized, it is wise for people to have rest periods. The curve, as the figures show, of the incidence of accidents in industry is low in the early morning hours, rises rapidly in the last hour before the noon rest. The curve is again low in the early afternoon hours and again rises to a very high point just before the end of the working day.

The tendency in modern industry is to have a worker do only one thing. This results in the worker using only one series of nerves and muscles, with a corresponding increase in the amount of fatigue. A man working in this way should have more frequent and longer rest intervals than the man who is working in a less specialized way.

A bitter controversy has arisen over this question of rest intervals. The controversy hangs largely on the interpretation of that slogan of the modern industrial world — efficiency. It is usually forgotten that the late Mr. Taylor, whose name is, perhaps, most widely connected with the exploitation of the so-called efficiency systems, advocated much more than the use of stopwatches on employes. He showed, for example, that a load of sand was more rapidly transferred by the use of a certain type of shovel. Moreover, it made a difference in time whether the worker began at the bottom or the top of the pile. Such considerations have generally been accepted as sound. Mr. Taylor went further and showed that certain motions enabled the worker to wield his shovel or other tool more effectively. If only these motions were performed, it saved time and muscular work. But Mr. Taylor and all except the most shortsighted efficiency engineers appreciated that the increased monotony counterbalanced, in part at least, the decrease in work. The time saved could be utilized in frequent rest periods and the output still increased. Many employers have eagerly accepted certain aspects of the doctrine of efficiency, but they have omitted the rest periods. Naturally organized labor has protested vigorously. Labor further objects that the complete acceptance of this doctrine tends to turn human labor into automatic mechanical labor. This is, of course, an obvious objection. However, it should be apparent that increased output and efficient work depend upon identical factors. With increased speed and monotony come increased fatigue and the necessity of increased rest periods to nullify the fatigue. Fatigue and efficiency are contradictory terms. An efficient workman is a healthy, fresh workman. A few farsighted employers are beginning to realize that, leaving out all considerations of kindness

or any humanitarian notion, it pays in increased output to arrange work so that the employes are healthy, and, certainly, a fatigued workman is not healthy.

Another count in the indictment against fatigue is that it creates a diminished resistance to infections. There is a greatly increased morbidity among the overfatigued, especially among women and children. One of the easiest ways of getting cold, for example, is the lowered resistance caused by fatigue. Fatigue also causes an individual to age rapidly, and it is also associated with various nervous manifestations. Curiously enough one of the most important effects of fatigue is to create an inability to sleep.

Sleep. The best antidote for work and its accompanying fatigue is rest and the best form of rest is sleep. Sleep is a somewhat complicated physiological phenomenon to which we should devote one-third of each twenty-four hours. But just as is the case with work or with other activities the amount of sleep which each individual requires varies enormously. Probably more individuals, in early adult life at least, require more than eight hours sleep than less than eight hours. Mr. Edison is said to need only four hours sleep in twenty-four hours, but this amount of sleep would, in a short time, spell ruin to the physical and nervous condition of the average person. Going without sleep has a greater effect upon the nervous and mental states than upon the physical. Experiments have been conducted in which people were kept awake for a long time — anywhere from three to ten days. The usual result was that after about three days the subjects would actually go to sleep with their eyes open, and some of the subjects would develop a condition closely resembling acute insanity. This condition is caused by fatigue. On the physical side, however, the immediate effect upon the organs and on the heart did not seem to be marked.

Many people — General Grant was an instance — take their sleep wherever opportunity offers, at any time during the day or night. On the other hand, most of us are governed in our sleep, in our method of sleep, and in our time of sleep by habit. If we do not get our regular amount of sleep, we tend to be "out of sorts."

There are other ways of getting rest in addition to sleep. A person may get rest by lying down, and he also gets rest even if it seems that he has passed a sleepless night. This consideration is of considerable importance, for it shows that fatigue can be lightened by rest. Furthermore, the idea of one day off in seven or of holidays is based upon this conception.

Recreation is also closely associated with the subject of rest and fatigue, for recreation has a marked effect on fatigue. The amount of recreation which any one individual needs is entirely a personal problem. Each individual presents a special case. All of us need a considerable diversity of occupation — a diversity of physical, nervous, and mental occupations. Here a number of emotional factors enter into consideration. If we like to do a thing, we do it easily and the consequent fatigue is lessened. There is such a thing as joy in labor and getting fun out of a task which makes work a form of recreation and markedly decreases the amount of fatigue.

Sleeplessness is another condition associated with fatigue, for overfatigue is one of the principal causes of inability to sleep. The average healthy individual who never feels fatigue never has any trouble in sleeping. But when we are overtired we tend to dream and our rest is broken. The cause is always a mental or nervous stimulus. Of course there are physical stimuli which keep us awake, but they are temporary conditions and are not really important considerations

in examining the problem of sleeplessness. Coffee and tea, for example, in the case of a large number of people, are a cause of sleeplessness. On the other hand, there are people, many Scandinavians for example, who go to sleep after drinking a large bowl of coffee. Tobacco may also cause sleeplessness. It is a common occurrence for certain individuals so to stimulate themselves by interest in some subject that they are unable to compose their minds and nerves sufficiently to sleep.

We know the condition where people do not sleep as they should under the name insomnia, a prevalent condition in modern life, which is due to the effects of fatigue. The treatment for this condition is simple, for it is only a question of developing regular and good habits of sleeping. The use of drugs or sleeping powders should be absolutely prohibited except when taken under the advice of a physician. It should be remembered that sleep is essentially a habit and, with the variations of the personal equation, the sleep habit is formed, interrupted, and broken, just as any other habit. While it is not given to all to sleep at will, still anyone with patience and persistence can acquire good sleep habits without resorting to artificial means. The converse is also true, for poor sleep habits can also be acquired. As is the case with any habit, regularity is the fundamental factor.

Dreams. Sleep is not a fixed state and it is sometimes difficult to tell whether a person is asleep or not. While we are asleep we are unconscious, but our subconscious mind is constantly busy in assorting the facts and impressions of the day. Our dreams are simply the reaction of our subconscious mind, expressions in thoughts, not in words, to the impressions which occurred during our waking hours. Formerly if we wished to emphasize the unreality and improbability of

a happening or of an idea, the stock phrase was to declare that such a happening or such an idea is as filmy as a dream, or made of such stuff as dreams are made of. The brilliant researches of Sigmund Freud and of Jung have demonstrated that dreams are not only based on the actual occurrences of life or of thought, but often reflect accurately the naked realities of past experiences without the confused draperies of the smothering artificialities of convention and of pride. While, as yet, dream analysis cannot explain reasonably authentic instances of the vivid portrayal of events happening simultaneously at great distances, yet such analysis offers a simple and logical explanation of most ordinary dreams.

The dream state is merely twilight and is most common in the transition between sound sleep and wakefulness. In such a state the conscious control of the thoughts is largely lost. While we may designate this, roughly, as the subconscious state, locomotion, for instance, may be possible. This is the state in hypnosis, where the control of thoughts and actions becomes delegated to another. In the subconscious state of sleep the current of thoughts flows with extraordinary rapidity, yet no completely new thoughts or ideas occur. All thoughts depend upon past experiences, but the associations and sequence of the thoughts in the dream state may be confused and absurd. On waking there may be no conscious recollections of the experiences of the dream. As has been stated, dreams do not consist of words but of thoughts, and, furthermore, dreams, like thoughts, are not confined to actual material happenings, for the mental experiences are registered just as surely as are material happenings. For example, the fear that some one may be drowned is registered in the mind as an experience of the past, often as vividly as an actual drowning incident.

Everyone dreams and all sleep is accompanied by dreams. But everyone does not recall the dreams on waking. The direction which dreams take is often influenced by the immediate surroundings, as, when it is cold, one dreams of freezing. Then the happenings of the day, often rehearsed after going to bed, may determine the scene of the dream. A constant mental worry is the classical cause of dreams as is seen in the terrors of the conscience stricken. Even the lower animals dream. The sleeping dog moves his legs and half yelps in his dreams of the chase.

But Freud and Jung have given a deeper significance to the dream state. Freud believed that in dreams those emotions which were sternly repressed in waking hours found their expression. Sexual emotions in human beings are repressed both by law and custom. In human society marriage, which permits the full expression of the sexual forces, is delayed, for most people, until well after the development of the sexual instinct and is denied to others. Such individuals, however, are not bereft of the emotions of sex. Freud, in particular, believed that in the dream state such emotions are dominant. As a result of this conclusion he built up an array of symbolic formulas by which no dream can be interpreted on other than a sexual basis. He believed, furthermore, that in the dream analysis which showed the repression of the sex emotions, he had the clue to the nervous states of many individuals. While all must credit Freud with an important share in the elucidation of a confused subject, there is a feeling that he overemphasized the sex element. But his work and that of his followers have shown us that dreams are merely records, perhaps disjointed, but still records of past experiences, and we now know the parallelism of the dream and other subconscious states. We are certain that events and

thoughts are recorded permanently in the wonderful registry of the mind and never lost. While an event may be forgotten in the conscious state, that event may be recalled in the dream state, the hypnotic state, or in other subconscious states.

The importance of all this may be illustrated by a single example. A person is always much upset by the fear of being alone in a closed place. This idea is fixed, an obsession. It interferes with the person's life, activity, health, and happiness. The dreams nearly always concern some frightful experiences associated with being confined in dark dungeons or the like. Sleep, with the almost inevitable dream, is feared. In the hypnotic state it is elicited that as a child the subject was punished by being shut up in a closet and forgotten for hours, to the abject terror of the child. In the conscious state the incident is entirely forgotten, but it had made so deep an impression on the mental register that it served as the basis for the subconscious mental activities.

Thus dreams, for the most part, can be explained. While their interpretation is by no means an exact science, most of us can find the basis of our dream in our past experiences, either as records of material fact, or, sometimes, as the startling records of thoughts, aspirations, and emotions which, perhaps, we fondly imagined we never allowed ourselves to entertain.

CHAPTER VI

Alcohol, Tobacco, and the Habit-forming Drugs

Alcohol

The controversy which rages over the subject of alcohol is so great and is waged with such bitterness that it has well given rise to the remark that alcohol is equally inflammable whether one touches a match to it or writes about it. Writers who have been so indiscreet as to endeavor to present the scientific knowledge on the subject have been bitterly assailed by the protagonists of one side or the other of the controversy, and their conclusions, based on scientific data and experience, have been outrageously condemned. Strange as it may seem, concerning a subject which has been the subject of debate since the beginnings of history, there has been, until recently, little available scientific information and few statistics concerning the use and abuse of alcohol. Even now, comparative statistics are in such a form as to be of little real value, and we can scarcely hope to make any definite progress toward a final solution of this problem until we attack it without prejudice and systematize the knowledge which we have at hand.

The general opinion seems to be that more alcohol is being consumed at the present time than at any other period in history. This does not mean, however, that there is more drunkenness, for, in point of fact, there is considerable evidence that there is less drunkenness and less abuse of alcohol than ever before. But on

account of the increased means of transportation and on account of the fact that the alcohol trade is always highly profitable, there is, at the present day, practically no alcohol-free people in the world. This world-wide alcohol problem cannot be discussed from any isolated point of view, for it is a problem of nutrition, of hygiene, of the individual, and of the community. The question must be considered in its economic relation as well as in its relation to hygiene.

Alcohol as a Food. From a strictly scientific basis, alcohol must be regarded as a food, for when a gram of alcohol is burnt seven calories of heat are given off. Alcohol, however, is not a tissue-builder, but a fuel. It has been proved that alcohol, in the absence of sufficient fats or carbohydrates, can be utilized in the body as a fuel food, but this use is limited and is restricted to about two ounces of alcohol daily. Two ounces of alcohol means about four ounces of whiskey — two or three ordinary drinks — or two and a half pints of five per cent beer. More than this amount is not commonly used in the body, but may be, and often is, stored up as fat. Since we have carbohydrates and fats, which must be taken in addition to supply the needed calories, it is evident that alcohol is of negligible importance as a food. Only in the occasional treatment of diabetes, during a starvation period or while the carbohydrates must be reduced to a very low point and the use of an excess of fats may be harmful, can the use of alcohol as a food be considered of the slightest real importance.

Alcohol as a Medicine. Life is in nowise dependent on alcohol and there is no controversy about the fact that a healthy person can live without it. But when we come to the consideration of the value of alcohol in disease, we encounter a wide diversity of opinion. There is no scientific evidence that alcohol is a stimulant in disease, despite the superstitions concerning its

wonderful stimulating qualities, although it may possibly be the case that the stimulating effect of alcohol cannot be tested by our present methods of estimating stimulation. The wide clinical experience of some of the wisest physicians, of whom Dr. Abraham Jacobi, of New York, is a leader, has convinced them of the value of alcohol in certain septic conditions, as pneumonia and diphtheria. Yet it is a fact that our best hospitals to-day use only a fraction of the amount of alcohol which they thought so essential a generation ago. Many physicians successfully treat sepsis without alcohol, and to the mind of the writer the experience at the bedside coincides with the scientific data that alcohol is not a stimulant in disease.

Little need be said concerning the common habit of carrying a flask of strong spirits against a possible emergency, — which is stretched to cover anything from fainting to tedium. Let a person be hurt in the street and there are always several volunteer amateur administrators of first aid who force brandy or whiskey down the throat of the afflicted. The only certain result from this procedure is the confusion of the surgeon, who often finds it extremely difficult to differentiate between the stupor of drunkenness and the stupor of injury. Alcohol is an irritating, highly volatile, quickly diffusible liquid and the beneficial effects in restoring consciousness after fainting are quite similar to those of other fluids, as solutions of ammonia, the aromatic spirits for example. Alcohol does relax the small peripheral blood vessels, but so do other substances and, anyway, loss of consciousness is only a symptom and of itself a harmless symptom. It must be admitted that the use of alcohol, while, perhaps, somewhat beneficial, is not important, certainly not essential, and can be replaced by other less harmful substances.

Since alcohol has the physiological property of exciting a fictitious sense of well being, it has been widely used in medical practice in the treatment of elderly persons and certain invalids, particularly convalescents, upon whom life bears heavily. Alcohol is used in such cases for its physiological effect of partially numbing the sensibilities and creating an artificial euphoria. It is not used as a stimulant or as a food. In such situations the use of alcohol often seems desirable, but it is not indispensable, nor is it entirely void of danger.

The Immediate Physiological Effect of Alcohol. The intricacies of the scientific work on this subject are tremendous, but in a general discussion of the problem it may be divided into two headings: the use of small amounts of alcohol, and the use of large amounts, or an excess, of alcohol. Most of us are familiar, through experience or observation, with the immediate physiological effect of alcohol. After a single drink there is a sense of increased comfort and well being. The discomforts of the body and the worries of the mind are less oppressive. There is an apparent quickening of the action of the mind and body. We feel that our phrases are better turned and our actions better timed. But innumerable experiments have shown that, while the subject was convinced that after alcohol he performed such tests as touching differently numbered buttons at the word of command with more speed and accuracy than before taking alcohol, as a matter of record his performance after alcohol was slower and less accurate. A large number of similar tests of speed and precision could be quoted, all showing that the effect of alcohol is to diminish the efficiency of any act requiring even the simplest coördinated activity of mind and nerve impulse. The amount of alcohol used in all these experiments was small, so small that the subjects and

the observers were often not conscious of any abnormality of appearance or behavior. We need go no further in order to draw the only and obvious deduction — that alcohol and work do not go together. Better work after alcohol is purely a fictitious belief. Of course the isolated exception, which does not need serious consideration, may also show that the numbing effect of alcohol on the abnormal and incapacitating sense of apprehension and diffidence may counteract the harmful effects and thus, occasionally, result in a better speech or a better contest.

The effects of large and excessive doses of alcohol are only too familiar. In large doses alcohol acts like ether or chloroform. There is the preliminary stage of excitement, mental confusion, and, often, excessive, incoördinated activity, followed by the characteristic stage of stupor and loss of consciousness. The penalty to the health in the consumption of alcohol, even in large amounts, once or even sporadically, is in itself probably slight and perhaps comparable to the single or occasionally repeated use of ether as a surgical anesthetic. But in the case of alcohol there are definite associated dangers. Accidents are frequent at times of alcoholic excitement and overactivity. Exposure to the physical elements and, of much greater importance, exposure to venereal and other infections are extremely common during alcoholic excess. There is a definite relation between alcohol and venereal disease, — in fact, this is one of the strongest indictments against alcohol. Furthermore, the excessive activity so frequently generated by alcohol produces fatigue, although the individual may not be conscious of fatigue during its production, but usually painfully so afterwards. A further associated damage is caused by the irritating effects of the alcohol on the digestive tract, which so often causes the stomach to rebel.

This insult and other insults to the orderly bodily functions may or may not be lightly tolerated by the human mechanism.

The Remote Physiological Effects of Alcohol. This implies a continuous use of alcohol. In the European countries, perhaps more notably before the war, alcohol was used in some form by a large proportion of the inhabitants. Italy, for example, heads the list in the consumption of alcohol, yet the Italians in their home country are a sober people. Drunkenness is not common. The people use alcohol moderately and do not abuse it in the ordinary sense. The Italians and the French drink with their meals and, in the evening, their light wines with their low alcoholic content. The Teutonic races do likewise with their light wines and beers. Presumably the total daily consumption of alcohol frequently exceeds two ounces of pure alcohol, although the total amount is small. The problem at issue is, granted that the consumption of even the smallest amount of alcohol hampers work and that alcohol has no place during industrial activity, does the consumption of this amount of alcohol, habitually taken, never to excess, do the individual harm? We cannot answer this question. The evidence of all sorts at hand, longevity and morbidity statistics and the like, fails to show that such consumption of small amounts of alcohol outside of working hours does the individual any harm. On the other hand, this consumption of alcohol does no good. Furthermore, no individual can be certain that his temperament and his environment may not conspire to increase the amount of alcohol consumed, so that he may acquire the alcohol habit and become a chronic alcoholic. While most such drinkers of light wines and beers do not change their habits, there are those who do.

The Alcohol Habit. Among bad habits, the alcohol habit easily ranks first in importance. The artificial euphoria so easily induced by alcohol brings temporary solace and comfort from the nagging troubles of mind and body. Many persons, however, seek this euphoria without any excuse. Others drift into the alcohol habit through various accidents of environment. The individuals who easily form habits comprise a distinct group. A somewhat unstable nervous system and a deficient self control are characteristic. It may well be that if this group did not have the alcohol habit, some other habit, equally bad or worse, might be substituted. But in addition to these persons of unstable mentality, strong-minded men and women who know all the evils of alcohol become enslaved to its use. Once the habit is formed, only the minority escape permanently. There are varying degrees in the alcohol habit, of which the advanced type is the most familiar. As a matter of fact the less advanced type is more common; the man who is never drunk, attends to his business, but who is only too well aware of the misery without his drink, and who is equally aware of the deterioration through drink and the dangers just ahead. He has sufficient self control to keep himself in hand as he says (which only means to keep his alcohol down to its lowest possible amount), but he would stop if he could.

In the alcoholic habit lies the greatest danger in the use of alcohol, for this always means chronic alcoholic excess and such an excess always means disease. As Koren[1] has recently pointed out, the dangers of alcoholic excess and of the alcohol habit lie mainly in the concentrated forms of alcohol and not so much in the light wines and beers. On the other hand, it can

[1] Koren, "Alcohol and Society," New York, 1916.

be urged with some justice that the path to the stronger alcoholic drinks often leads from the use of the lighter drinks.

Alcoholic Excess. There is, and probably never will be, no agreement as to what constitutes alcoholic excess. For one man a single drink is excess, while another seems unaffected by the daily consumption of considerable alcohol. Although the amount of alcohol which can be burnt, namely two ounces, may in general be taken as the dividing line, the usual and a good working conception of alcoholic excess means the daily consumption of at least twice that amount.

Those who habitually use alcohol to excess divide themselves, roughly, into three groups. In the first group we have the actual social drunkard, perhaps the most common type. He rarely, if ever, drinks alone. With him drinking is largely a matter of environment, yet he tends, but not inevitably, to increase his consumption of alcohol and alcohol often "gets him." Such a type is usually easily cured by the elimination of alcohol and a change in the environment.

In the second group comes the steady tippler upon whom the habit has its firmest hold. He — many of them are women — drinks whenever the craving calls. He is not so often drunk as the social drunkard, but, in the end, he rarely goes to bed in a condition even approaching sobriety. He is the type who has to start the day with a drink to steady his nerves and settle his stomach. His is the alcohol habit and this is the hardest type to break.

The third type goes under the name of dipsomania. We have a feeling that this term is mainly used as a convenient excuse for irregular behavior. It is true, however, that there are certain individuals who are afflicted with this, and it is probable that their deficiencies are temperamental. The so-called dipso-

maniac is the person who goes without alcohol for weeks and months, and then goes on a terrific spree. Apparently all the cures in the world do not affect him. Once started on a spree, he will drink and drink, pawn his clothes, sleep in the gutter, and still continue drinking as long as he can get anything to drink.

Alcohol and Disease. Chronic alcoholic excess leads to physical, mental, and moral deterioration, effects with which we are all familiar. The finer sensibilities are the first to go. The primitive emotions, however, persist and become dominant, as instanced by the fear of the alcoholic in delirium tremens. So, too, the reformation of the chronic alcoholic — the cessation of alcohol — leaves the victim with a deteriorated body and mind. The body is often easily built up, but the reconstruction of the mind is more difficult and sometimes impossible. It is this situation, in the period before complete mental reconstruction, that favors relapse. Alcohol is peculiarly a nerve poison. So there are cases of typical alcoholic neuritis, while cases of alcoholic insanity are both numerous and common. About twelve per cent of the admissions into hospitals for the insane are diagnosed as alcoholic insanity. A large proportion of these cases regain their sanity.

Alcohol causes many disturbances of the body that are purely physical. The "gin drinker's liver" (one form of cirrhosis of the liver) is directly associated with alcoholic excess. However, many of these disturbances which are commonly ascribed to alcohol are only indirectly caused by it. It is often not so much the alcohol itself as the contributory effects or the effect of certain conditions induced by alcohol. The contributory effect of alcohol is well illustrated by the high death rate of alcoholics who have infectious diseases. Pneumonia in a chronic alcoholic is, perhaps, not invariably

fatal, but nearly so. Then, too, alcoholics acquire infectious diseases more readily than healthy persons. As shown by the insurance statistics the alcoholic has definitely lowered his expectancy of life. Alcohol is accused of being an important factor in the production of arterio-sclerosis and other degenerative processes. Since degeneration is often the end result of wear and tear, we hardly need alcohol to explain early senility in the alcoholic, who, on account of his alcohol, has been abusing the human machine by irregular habits of eating and sleeping, and by exposure to accidents and disease, particularly to the venereal diseases, of which syphilis is in itself a direct cause of arterio-sclerosis. If we add the factor of poverty, insufficient food and shelter which so commonly follows in the wake of alcoholism, we have an easy explanation of the early wearing out and wastage of the bodily machine of the alcoholic.

Alcohol and Posterity. Alcoholism limits the offspring, but chiefly through associated conditions. In animals alcohol itself diminishes the number of inferior offspring. Since the alcoholic is essentially physically deteriorated, the alcoholic mother gives her children a poor beginning in life. It is doubtful, however, whether alcoholic tendencies are inherited, for the development of tendencies to alcoholism are probably due to the environment. Furthermore, the inferior offspring of alcoholic parents can trace their inferiority to the associates of alcohol, rather than to the alcohol itself.

Alcohol and Crime. Many crimes are committed under the influence of alcohol, for many criminals drink to excess. But it does not follow that alcohol is intimately related to crime. The criminal, often a defective, demonstrates his inferiority both by his criminal instincts and his alcoholism.

Alcohol and Poverty. Alcohol is only too frequently the cause of poverty and much economic waste. The attendant want and misery is enormous. Nevertheless alcohol is not the sole cause of poverty, for poverty would exist even without alcohol. It must be accepted, however, that without alcohol there would be less poverty.

The Solution of the Alcohol Problem. It is generally believed that the alcohol problem has in no way been satisfactorily solved. On the whole, legislation against drink has failed to do what was expected of it. All parties are agreed that there are harmful results connected with the use of alcohol. All are agreed that most of the harmful effects of alcohol arise from the use of drinks with a high percentage of alcohol. All admit the danger of acquiring the alcohol habit, particularly if strong drinks are used. The drinking of alcohol on an empty stomach, as in the American cocktail habit, and the taking of "bracers" at any time and especially at all regularly, are sources not only of danger but also of actual damage. No one believes that drunkenness is anything but an evil. All are agreed that there should be an increase of knowledge concerning the evil effects of alcoholic excess. While there are many proposed solutions of the problem presented by the conditions, perhaps the two most important may be briefly discussed here.

Any proposed solution of the alcohol problem depends upon the viewpoint. From the personal point of view of the individual it is often argued that the occasional use of a small amount of alcohol, preferably in the form of light wines and beers, at times which do not conflict with work, probably does no harm. The experience in Europe, particularly in Italy, is cited to substantiate this view. It is granted that abuse of alcohol is bad and that a few exceptional

individuals should never drink. The arguers for this viewpoint believe that since harm comes from alcoholic excess, a more intelligent realization of the dangers of excess will result in a decrease in the abuse of alcohol. From this viewpoint remedial legislation is suggested by Koren and others, based upon a careful investigation of the Gothenburg and other systems, which practically legislate the strong alcoholic drinks out of existence by excessive taxation and which bring the alcohol traffic under adequate control.

From the broader viewpoint of the community interest in this economic and social problem, the more radical solution of complete suppression or prohibition is suggested. It is pointed out that alcohol is not absolutely essential as a food or as a medicinal remedy. A knowledge of the dangers of alcohol does not prevent educated people (doctors, for example) from falling a prey to its ravages. Furthermore, alcohol is a habit-forming poison. Hence, in view of its harmful effects and since it adds nothing that is essential to human life, many people would prohibit its manufacture and use as a beverage.

Certainly it seems that the logic is with the latter view. Unenforced prohibition, however, leads to the worst evils of alcoholism, — secret tippling, vile products, and concentrated forms of alcohol. Moreover, alcohol is so readily produced by fermentation and distillation that prohibition is difficult of enforcement. Prohibition will be enforced and will prohibit alcohol only with the genuine backing of the community. Recent years have seen a worldwide movement in favor of prohibition. The European War created a situation in which almost despotic power enabled England, Russia, and France to enact drastic laws that otherwise might have only resulted after years of discussion. But the movement began long

before the war. It began with the accumulation of the evidence of the evils of drink and of the economic waste, particularly of individual efficiency, caused by alcohol. Whether the liquor regulations in Europe can continue after the war depends on the support given the legislation by the several peoples. For drink laws, either in Europe or America — and this has been thoroughly proved by the experience of many of our states — are, in the end, not enforced by the so-called government, but by the people themselves.

Tobacco

The use of tobacco is generally regarded as a rather expensive, time-consuming habit. Despite the somewhat intemperate denunciation of the tobacco habit and the extravagant portrayal of the harmful effects of the use of tobacco, the world at large refuses to regard the tobacco problem as very serious or important. It is granted that the first cigar usually causes nausea and that some people smoke too much, but, likewise, any unaccustomed experience, such as ball playing, is often accompanied by definite discomfort. Then, too, anything — even exercise and work — may be carried to excess. In training for physical contests, tobacco is generally forbidden, which means that the use of tobacco is roughly classified in the same category as irregular hours and meals — that is to say as minor things which tend to disturb the balance of a perfectly adjusted machine. The tobacco user labors under no delusion that his health is benefited by the use of tobacco or that he smokes from any other reason than his physical enjoyment. Smoking provides him with a trifling occupation and a pleasurable sensation which is extremely agreeable and restful.

Scientific investigations indicate that chewing and

smoking of tobacco in any form give the same results. The stimulating effects of tobacco are so slight and transitory as to be negligible. Tobacco, as weed or smoke, contains several poisons, of which the most important and the best known is nicotine. This substance is highly poisonous to the lower animals, but, so far, it is impossible to correlate the findings in animals with the findings in man. The effects of an excess of tobacco in man, which means an excess of nicotine, are fairly well known. There is nausea, and then physical, mental, and nervous depression. Some people are made temporarily blind by the excessive use of tobacco. Others develop the so-called " tobacco heart ", which is merely an increased irritability of the nervous mechanism that regulates the heart action. This condition is often alarming, but it ceases with the omission of tobacco and there is no evidence that there is any structural damage to the heart.

A fairly general effect of tobacco, which is somewhat similar in its origin to the tobacco heart, is seen in the acceleration of the pulse and the disturbance of the blood pressure after the use of tobacco. These phenomena are due to an increased irritability of the vasomotor system, that is, the nervous mechanism which regulates the size of the blood vessels and the blood flow. This condition is usually transitory and is somewhat similar to the phenomena observed in many states of nervous irritability due to excitement from various causes. These phenomena occur in still other conditions and their importance depends upon the underlying causes. Of themselves such manifestations as an accelerated pulse and disturbance of the blood pressure are not serious. Like the tobacco heart, they may give rise to disagreeable sensations, but there is no evidence, as yet, that such manifestations, which subside rapidly with the disuse of tobacco,

indicate organic heart disease or portend future damage even when made persistent through the continuance of tobacco.

The effect of tobacco smoke may be irritating to the respiratory tract. The cigarette smoker's cough, for example, is only an evidence of such irritation. As an irritated mucous membrane favors infection, tobacco smoking may indirectly cause disease, but there is no positive evidence that the use of tobacco causes cancer, as is so often claimed. The excessive use of tobacco causes, as is well known, an increased nervous restlessness and many susceptible persons find that an increase of their tobacco allowance before bedtime will keep them awake as effectively as an excess of coffee will keep others awake.

In spite of many attempts to throw upon tobacco the burden of the causation of the increase of our degenerative diseases, the statistics, when scrutinized carefully, have so far been negative. Tobacco, to be sure, is largely used by self-indulgent people. But such people sit long at the table, consume considerable alcohol, and have many other poor habits of hygiene.

Two popular superstitions in regard to tobacco require a word. The cigarette is popularly regarded as the most dangerous form of tobacco. It is perhaps true that the cigarette smoker gets more of the contained poison than the smoker of a pipe or cigar. On the other hand, the poisons of tobacco are proportional to the amount of tobacco, and, during a day, a cigarette smoker will get less poison, since he will use much less tobacco. This is the common experience of the beginner, who can often smoke a cigarette without discomfort, but is usually made ill by a cigar or a pipe. Another superstition is that cigarette smoking causes all sorts of ills, perhaps most notably stupidity, feeble-mindedness, and insanity. Cigarette smoking is not

the cause of these conditions, but is caused by them. In other words, the cigarette habit is merely one of the many expressions of the unstable nervous system to which such people easily become addicted.

Since the use of tobacco is in nowise beneficial and may disturb certain bodily functions to a greater or less degree, the use of tobacco is, by general consent, rightly denied to the child, particularly sensitive to such disturbances and requiring the greatest possible efficiency of organic action for growth and development. The adult, more stable and less susceptible, is likewise not benefited, but he is not greatly and, apparently, not permanently disturbed by tobacco.

In conclusion, the accumulative evidence coincides with the popular view and practice. The use of tobacco is in nowise beneficial to the health. It is a habit, but apparently not a vicious habit. The moderate use of tobacco does not shorten life nor in itself cause serious disease. The excessive use of tobacco, like other excesses, is disturbing to certain bodily functions, mainly the stomach, the blood pressure, and the nervous system. However, the ill effects are transitory. In general, the moderate use of tobacco may be regarded as a petty extravagance, not, perhaps, entirely harmless, but without any serious train of physical consequences.

Patent Medicines and Secret Nostrums

Patent medicines and nostrums may be divided into three classes: (1) Those that contain dangerous and habit-forming drugs; (2) those that contain legitimate remedies; and (3) those that contain no drug or remedy. The first two groups evidently may affect health. Legislation and publicity have largely eliminated the dangers from patent medicines and secret

nostrums, whereas, heretofore, prominent men sang the praises of patent medicines which were practically whiskey. Now merciless publicity and the bald statement of the alcoholic content on the label have eliminated such articles as sources of real danger. A man now has the requisite information so that he can exercise his preference, if he desires alcohol, between whiskey and the so-called medicine. So, too, such secret nostrums as the asthma cure, which contained a large amount of cocaine, have been eliminated. The cocaine did temporarily relieve the asthma, but, in the end, the sufferer had both his asthma and a drug habit. Many of the so-called pain killers and soothing syrups contained opium.

It should be understood, however, that a patented medicine is not necessarily bad. Arseno-benzol, or Salvarsan, Ehrlich's great discovery, so commonly known as "606," is a patented article. Not only the product but the process was patented. Many of the coal tar products, so widely used for headaches and insomnia, are patented products. While there is every justification for the patenting of any product, nevertheless it is to the credit of medical science that, owing to the belief that human remedies and human suffering ought not to be capitalized, few medical discoveries have been patented or seem likely to be. In all fairness it should be stated that the proceeds from the sale of "606," under the patent rights, are entirely devoted to the development of such scientific work as made possible the discovery of "606." Other patented products which are widely and legitimately used are certain modifications or combinations of well-known drugs. Adverse criticism in this case is directed entirely at dishonesty either of an unusually high selling price or unscrupulous "cure-all" advertising methods.

The objection to the use of any unknown so-called

remedy must be obvious, even in the absence of dangerous drugs. Most secret nostrums contain some remedial agent which is usually one that acts quickly, for patent medicines are made to sell and to make money for the owners. Since the benefit to the taker is, of course, a consideration secondary to the commercial profit, the benefit depends solely on the altruism of the seller.

All medicine and all drugs, while beneficial in appropriate amounts, are, nevertheless, poisons in large amounts. Unnecessary drugging merely means more poison, of which the system must rid itself. Furthermore, the remedial agents in the average patented medicine and nostrum can usually be purchased at a small fraction of the price of the advertised article. Epsom salts, so commonly used as a purgative, can be bought for a few cents a pound, but in a decorated bottle they usually cost many times that amount. If these arguments were not sufficient, it might be added that only in times of serious trouble does Nature require the aid of drugs. Self-drugging is a pernicious habit and popular pills for constipation, for example, have probably fastened constipation on more people than they have aided. Few cases of constipation require adventitious aids in the form of pills, except for temporary relief.

While people are exceedingly reckless with their money and invest in wildcat schemes, they are much more reckless with their bodies and the drugs which they administer to themselves. Just as people will read lurid advertisements promising wealth and invest money in gold mines in lands which do not exist, so the individuals read lurid advertisements about health and buy medicines to cure ailments that they never had or which are incurable. Such advertisements are not limited to medicinal preparations. All sorts of medical

treatments and systems are advertised in the same way. A type of doctor, popularly and often correctly known as a " quack ", uses screeching advertisements. His methods and his value are those of the objectionable patent medicines and secret nostrums. Since it is almost the invariable custom of the medical profession not to insert advertisements in the lay press, it becomes a simple matter to put a proper valuation on the advertised promises and the services of the men who advertise.

A favorite ruse in the advertisement of a remedy or of a " quack " is to enlarge a normal symptom into a serious disease and guarantee a cure. Most urines will have a brick dust sediment if left in a cold vessel. This common phenomenon is frequently advertised as a symptom of Bright's disease and curable by a few bottles of some remedy. That the person will be well after taking the medicine is a reasonable supposition if the medicine is innocuous, as it usually is.

A ruse which is particularly contemptible, since it causes unnecessary mental suffering, is the advertisement of a cure-all, especially designed for sufferers from diseases so advanced as to be incurable. Of course some of the supposed sufferers will not be diseased and so will be easily " cured." But, in the majority of cases, the distracted family or friends, convinced by a lurid advertisement that a new and wonderful cure has been discovered, fall victims to their gullibility and their affection for the sufferer. The enforcement of the law regarding the use of the mails to defraud and the creditable refusal of many newspapers to accept such advertisements, even at considerable financial loss, are constantly tending to protect the public from these unscrupulous schemes.

It is quite possible for a person to go through life without the use of drugs. It is possible for a person

successfully to go through an illness without drugs. Good habits of living are far more important than drugs and it is the part of wisdom to omit them from the daily life. Incidentally, the household medicine chest, through unnecessary and unskilled drugging, causes at least as much harm as good. Drugs are valuable and often necessary, but their use should be directed, not by sympathetic and unskilled friends, but by the skilled and experienced expert.

Habit-forming Drugs

In the United States, publicity and two acts of beneficient legislation have largely eliminated the frightful dangers of the drug habit. By the Food and Drug Act, commonly and incorrectly known as the Pure Food Law, articles of commerce containing the dangerous drugs, including alcohol, must state on their labels the amount of such drugs. As many of the widely advertised remedies contained opium, cocaine, and their derivatives in large amounts, the almost inevitable result of the widespread use of such products was a large number of innocent drug fiends. More recently the so-called Harrison Law has wisely restricted the sale of opium, cocaine, and the like. By the provisions of this legislation it is no longer possible to buy these drugs over the counter, and even the doctor's prescription has to bear his signature and his license number under the act, and cannot be refilled indefinitely as heretofore.

Probably we shall always have some drug and "dope" fiends, for legislation will never prevent all law breaking. Moreover, opium and its derivatives — morphine, codeine, heroin, and the like — and cocaine and its derivatives are necessary medicinal drugs. The blessings of morphine and cocaine are tremendous,

but their habitual use occasionally arises from their use as medicine. It is unnecessary to dwell on the effects of the drug habit. The typical drug fiend is, and ought to be, regarded as sick, mentally, morally, and physically, and, too often, incurably sick. Every mental faculty and the entire energy of the body are devoted to one purpose — the use and procuring the drug to which he is enslaved.

Any one who takes opium, cocaine, or their derivatives, whether from the idle desire to experience a novel sensation or for the relief of pain, without medical direction, is playing with the deadliest fire known to medical science. There are, of course, instances of complete cures and complete restorations to normal life, but such cures, unfortunately, are in the very small minority. In this country a person must either be blind or a deliberate lawbreaker to inaugurate the drug habit.

While opium, cocaine, and alcohol are the most common, as well as the most important and most devastating of the habit-forming drugs, yet the actual list is long. There is the ether habit and the belladonna habit, but neither is common and the habit does not enslave the victim quite so completely as opium, for example.

In recent years the chemists have evolved, largely from coal tar products, a number of drugs which are widely used for the relief of headache or insomnia. Since these afflictions are recurrent, many people keep supplies of such drugs for instant use. It is particularly true in insomnia that the drug works well for a time and then the dose has to be increased, until sleep is impossible without a tremendous dosage. All these drugs are depressants and, in excessive amounts, may cause death. The sleeping powder or tablet habit is worse than insomnia. Such drugs do not cure the

underlying causes of the headache or the insomnia; they merely temporarily remove the objectionable symptoms.

The indiscriminate and unsupervised use of drugs tends to lead to abuse and the incapacitating drug habit. The dangers lurking in the use of drugs are so subtle and so great that no matter what the temptation may be the only wise course is never to use them except under expert supervision.

CHAPTER VII

Light and the Eyes

While we are accustomed to consider that the rays of the sun have performed their functions when they have given us warmth and light, the sun rays have other very definite powers. Sunlight, for example, is an excellent disinfectant. Furthermore, while the subject is not thoroughly understood, some of the sun rays have peculiar and mysterious influences on the human body. An appreciation of the beneficial effects of the sun rays has led to their use in the treatment of disease, — heliotherapy. In addition, it seems possible that the beneficial effect of outdoor living and sleep may be due, in part, to some mysterious activity of the sun rays.

But the chief value of the sun in everyday life is in the illuminating property, for most of our activities are directly dependent upon our ability to see. Loss of sight is a far greater industrial handicap than the loss of limbs or of hearing, or of any physical infirmity. Under the conditions of modern life, however, our visual apparatus frequently becomes impaired through the strains to which it is subjected, and this, in turn, leads to physical conditions which impair our mental and bodily welfare.

The eye is a complex organ and vision is a complicated physiological process. There is practically no such thing as a perfect eye or a perfect vision, but most of the imperfections are so slight as to be negli-

gible. The usual defects in the eye are present at birth, and this is also true of color blindness, a distinctly hereditary defect in vision — not apparently in the eye — which is largely confined to males. These congenital defects are usually defects of refraction of light, but sometimes they are defects in symmetry, or cross eyes. Nearsightedness or inability to see well objects at a distance is a common condition. This merely means that the eye is improperly constructed and that the image of distant objects cannot be focused on the retina. Nearsightedness, as well as the farsightedness of age, is easily corrected by glasses, and it is imperative that such defects should be corrected as soon as they are detected.

The usual defect in the eye is astigmatism, which is an inequality of curvature of one of the refracting surfaces of the eye. Here, as always, Nature tends to help defects. The squinting of a person trying to gain better vision merely means that while the little muscles within the eye are trying to overcome some handicaps, unconsciously the person sympathetically contracts certain external muscles.

With age definite changes occur in the eye. The person finds, for example, that he cannot focus at nearby objects, usually a book. This condition is a difficulty in mechanism, since distant objects are seen clearly. As Holmes remarked, "My eyes are all right, but my arms are not long enough." Age brings with it real degeneration in the eye as in other organs. These changes can be prevented only as age is prevented.

Eye-strain. Extraordinary efforts on the part of Nature to overcome handicaps may be due not only to defects in the eye, but also to overuse or to poor illumination. Whatever the cause, the result is the same, the so-called eye-strain. Overwork of the eyes

causes the same train of symptoms of general fatigue as any form of overwork. Eye-strain, in particular, is the cause of headache, dizziness, and nausea. It often occurs that a person with supposedly good vision rather suddenly develops symptoms of eye-strain. Such a sudden onset merely indicates that, while Nature had previously easily compensated for the defect, a combination of overuse and the defect, or a combination of fatigue or illness and the defect, could not be counteracted. Thus, some defective eyes go through life without poor vision or eye-strain, but the majority of people with defective eyes, who use their eyes to a considerable extent, finally come to the necessity of glasses. Glasses merely correct the defect. It is comparatively easy to select glasses for the near- or farsighted person, but the astigmatic person requires a delicate adjustment, since an incorrect glass may, in reality, give him more astigmatism than his original defect. But the most important factors in eye-strain are overuse and an improper light. It should be remembered that the eyes are subject to the same fatigue as any other organ and the early warning of fatigue should be heeded.

Illumination. Strong light, either sun or artificial, which shines either directly or by reflection, is injurious through causing strain. Snowblindness, for example, is caused by reflected sunlight. From the same causes, it is important carefully to look to our light for reading and to avoid as much as possible the smooth paper of certain books. With artificial light the increased use of the indirect and semi-direct system of lighting is desirable. Large halls brilliantly illuminated by scattered clusters of exposed bulbs will usually tend to increase strain of the eye, since it is nearly impossible to avoid a direct or reflected intense light.

We have no actual tests for insufficient illumination, but the consciousness of an enforced strain should be adequate warning. In the matter of the different forms of illumination, the important consideration usually is the securing of adequate light with the avoidance of the direct intense light.

Diseases of the Eye. The eye is subject to a variety of inflammations, but only three are of general interest. Pink eye or conjunctivitis means a superficial inflammation of the eye caused by the introduction of bacteria. There are epidemics of pink eye, where the bacteria are passed along by some articles, usually towels, used in common. Simple conjunctivitis is, as a rule, not serious, but is quite unnecessary, as usually the introduction of the bacteria depends on gross carelessness.

Trachoma is an infectious condition of the lids and the surface of the eye, which seriously menaces the vision. It was formerly thought that the disease was largely confined to Europe, and stringent regulations were adopted to prevent the entrance of the disease into the United States. Recent investigations have shown, however, that trachoma is not uncommon in this country. It occurs most frequently in unsanitary conditions and it is spread by the careless use of common articles. The course of the infection is slow and actual cure is not common.

One form of conjunctivitis is very serious, for the inflammation does not remain superficial, but spreads to the deeper structures and causes blindness. This form is caused by the bacterium of gonorrhea, the gonococcus. This condition is seen occasionally in careless adults, who thus pay a severe penalty for the gonorrhea, in the first place, and for their gross carelessness, in the second. Gonorrheal conjunctivitis or gonorrheal ophthalmia, to give the technical term,

is, however, most common and devastating in the new born, and is the cause of at least ten per cent of all blindness. About one third of the blindness of the children in the schools for the blind originated in this way. The baby's eyes are infected during the process of birth, and, unless prompt and skilled treatment is administered to the infected baby, the sight is usually lost and the child is condemned to a life of darkness. These cases are, unfortunately, so common and so tragic in the outcome, if neglected, that many states require immediate reporting of all suspicious diseases so that adequate treatment may be insured. All physicians are urged to, and many actually do, disinfect the eyes of all new born babies, irrespective of the social status of the parents.

Accidents to the eyes which entail partial or complete loss of vision are common in the modern industrial world. Employments which involve the throwing off of small particles of metal or stone are especially a menace to the eyes. Theoretically, practically all industrial blindness is preventable. As a matter of practice most of the blindness is preventable through the enforced use of protective apparatus, such as goggles. Certain poisons, such as lead and wood alcohol, may affect the sight, and the excessive use of tobacco may also cause temporary blindness.

In general, the eyes are so important that the best expert treatment is always justifiable. Amateur tinkering with the eyes, even in the removal of foreign bodies, may be very costly to vision. Expert knowledge is particularly important in the fitting of glasses for the astigmatic eye, for it may be, and usually is, necessary completely to dilate the pupil in order satisfactorily to test the eye. When glasses are worn, since they are employed to correct refractive errors, it is obvious that the glasses should be fixed accurately

and symmetrically. Accordingly spectacles are more desirable than eye-glasses. It is remarkable how few serious accidents are due to injury to the eye-ball from broken glass of either eye-glasses or spectacles. The eye is well protected through the reflex protective membrane.

CHAPTER VIII

THE HYGIENE OF THE TEETH AND THE UPPER AIR PASSAGES

Dental Hygiene. Education concerning the proper care of the teeth has progressed to such an extent in the United States that we, as a people, have the best cared for teeth in the world. This is a marked step forward towards good hygiene, for many ills come from neglect properly to conserve the teeth. Although it is generally overlooked, the teeth are extremely important in forming the architectural structure of the mouth and lower face. Thus any development deformities in the teeth may cause interference with the functions of the nose as well as of the mouth. Furthermore, on account of the anatomical proximity, diseases of the teeth are closely related to diseases in the nose, throat, and even the eyes.

The principal use of the teeth, of course, is to masticate food, and this is a vital process in securing good digestion. Like the other organs of the body, proper exercise is necessary for the well being of the teeth. Under the artificial conditions created by civilization the teeth rarely get sufficient exercise, which has caused a marked deterioration in them and necessitated a large amount of care to insure cleanliness and prevent decay and disease. However, the lower animals, while not so dependent on frequent cleaning of the teeth as man, are not exempt from dental disturbances.

Poor teeth may be inherited, or they may be the result of malnutrition on account of illness during their development, or they may be the end result of faulty care. The last factor is by far the most important, and this is preventable. While theoretically a proper diet might be supposed to keep the teeth healthy and clean, experience shows that healthy and clean teeth are, in general, exactly relative to the use of cleaning methods, the toothbrush, the toothpick, and dental floss.

The decay of teeth is roughly proportional to the amount of accumulated food. The food not only brings bacteria, but furnishes a good culture medium for the bacteria which are normally present in the mouth. The chemical products of the bacterial action and the bacteria themselves attack the teeth and decay results. Decayed teeth mean interference with mastication and tend to inaugurate digestive disturbances. Furthermore, decayed teeth eventually mean infection. Of late we have been discovering the important rôle of infection in and around the teeth in systemic disease. Certain mysterious fevers and forms of rheumatism can be traced directly to infected teeth. Good teeth are a definite cosmetic asset, while poor teeth cause pain, suffering, and economic loss. Poor teeth are a source of digestive disturbance and infected teeth are an important cause of systemic disease.

The prevention of these conditions lies in simple cleansing of the teeth and gums. Preferably the teeth should be cleaned after each meal. In any event accumulated food should not be allowed to remain overnight. While the teeth of certain fortunate individuals are easily cleaned, most people require the use of a brush and a fine, simple powder in order to insure cleanliness. Others rapidly accumulate on their teeth a substance which infects the gums and causes Rigg's

disease (pyorrhea alveolaris) or receding gums. In such cases the periodic aid of a dentist is required to keep the teeth clean.

The vigorous exercise of the teeth, scrupulous cleanliness, and frequent visits to the dentist to detect and eradicate incipient decay are simple, but effective, means of insuring sound teeth.

The Upper Air Passages (the Nose, Throat, and Ears). The chief function of the nose and throat is to make the air which goes into the lungs warm and moist. In complete mouth breathing this important function is inadequately performed. In addition the mouth and throat, of course, serve as the passageway by which food gets into the stomach, and the whole anatomy of the nose and throat is designed for the increasing of resonance. The anatomical connection of all these structures is an important consideration, since it affords the opportunity for an easy extension of infection and disease from any one to all.

The upper air passages are the main avenue by which disease germs enter the body. It is obvious that when we breathe air which contains bacteria, these microorganisms will be drawn into the respiratory tract in the process of breathing. The peculiar anatomical structure of the nose and throat, with their large convoluted surface area, especially adapted to heat and moisten the inspired air, also enables these surfaces to act as a filter for particles of dust and moisture, many of which contain bacteria. There is a large group of diseases — colds, tonsillitis, whooping cough, diphtheria, bronchitis, tuberculosis, and pneumonia — whose effects are largely confined to the respiratory tract. The disease germs are given off in droplets in breathing, as well as in coughing and sneezing. There is another large group of diseases, as measles and smallpox, in which the disease may be regarded, perhaps, as

more general, but the avenue of infection is through the upper respiratory tract through the infective droplets given off by persons having the disease. There is no sharp differentiation between the diseases of these two groups. A purely local infection may, at any time, become general. In pneumonia, for example, the disease germs are often present in the blood stream. Moreover, in all these conditions the infective bacteria are present in the discharge from the nose and throat.

The Common Cold. Statistics collected in Boston show that more time and money are lost through the common cold than through any other cause. Consequently, contrary to the general belief, the common cold is of real industrial as well as of hygienic importance. Colds, as most of us have learned through our own experience, cause inconvenience and suffering, and may produce permanent damage in addition to economic loss. Among the possible complications and sequelæ of the common cold may be listed rheumatic fever, pneumonia, nephritis, and a depressed vitality which allows other infections to get a hold on the body or aids the progress of organic disease.

Bacteria of disease are almost inevitably present in the air we breathe in our daily intercourse with people. Adequate ventilation and reasonable individual care will limit, but not eliminate, the breathing in of bacteria. Consequently we are continually forced to rely on other defenses against air-borne infections. In order to avoid these infections transmitted through the upper air passages the individual must start with a normal nose and throat, for abnormal conditions of these structures always favor infection. It is a common experience that the correction of abnormality of the nose and throat, such as a deviated septum and enlarged tonsils, often rids the individual of the tendency to recurrent colds.

The second defense against these infections is keeping in good bodily condition. Constipation, for instance, through lowered bodily resistance, may indirectly cause a cold, and so a dose of salts, calomel, or castor oil may assist in the rapid disappearance of a cold. Vitiated air, dust, drafts, sudden changes of temperature, exposure to wet and cold, overwork, loss of sleep, improper food, all lead to a reduction in vitality and so allow infection to develop.

Irritations of the nose and throat are also contributory factors in causing colds. Foremost in these irritations is that from dry, hot air. Smoke, dust, and fog are also important irritants.

Three things, then, the abnormal anatomy of the nose and throat, the physical condition of the body, and irritations, are the contributing factors to causing colds, and their connection is important in the prevention of colds and other air-borne infections. *But the actual causes of these diseases are bacteria.* The general superstition that colds are due to drafts, chilling of the body, and the like has only the basis in fact that they produce a condition favorable for the development of the bacteria which are always necessary to produce the cold or other infection. Colds are contracted from other people who have colds. The men who went on expeditions with Peary to the polar regions did not suffer from colds in spite of the low temperature, because there were no bacteria there. An appreciation of the droplet method of infection will go a long ways toward decreasing the number of colds. It is only in this way that the cold-causing bacteria are transmitted from one person to another and that colds are actually contracted.

Besides the ordinary cold — the term may be stretched to include laryngitis and tonsillitis or sore throat, — there are other definite infections of the

nose and throat. The so-called children's diseases — diphtheria, scarlet fever, measles, and the like — have their origin in the nose and throat. So it happens that oftentimes when a person is supposed to be coming down with a so-called cold, he is, in reality, coming down with one of these diseases. For this reason, as well as to stop cold infections, logically, we should quarantine for ordinary colds as much as we quarantine for measles or any of the children's diseases. The only difference between measles and colds, for example, is that the complications of measles justify a more strict quarantine. It is only fair and reasonable, then, that the individual who has a cold should take it upon himself to see to it that he does not spread the infection and thus endanger the health of others.

Adenoids and Diseased Tonsils. At birth there are certain structures in the throat, which are known as adenoids. As the child grows older, these tend to disappear and in adult life they are of little consequence. On the other hand, adenoids in a child may be of serious import. They may prevent breathing through the nose and, by causing mouth breathing, cause the well-known adenoid facies with the large receding chin and change the entire appearance of the face. Abnormal breathing through the mouth seems seriously to affect not alone the physical development and energy, but also the mental development and energy. Many backward and stupid children become normal and alert pupils after the removal of their adenoids. These growths should be treated as any other obstruction of the nose and throat and they usually require removal by a surgical operation.

The tonsils are particularly important in the question of disease and its prevention, because it is through the tonsils that germs of great importance in the production of disease get into the body. Rheumatic

fever, for instance, almost always starts with an infection of the tonsils. Through the tonsils come the infections which cause the damaged kidneys and hearts in young people. Thus, at the first sign that the tonsils are failing, usually on account of disease, properly to act as filters and that bacteria are permitted to pass through, the tonsils should be removed. If the tonsils are not removed, in a case of heart disease for instance, the disease will frequently tend to increase, through a repetition of the infection from the diseased and poorly functioning tonsils.

The Eustachian Tubes. A little behind the tonsils, leading from the throat, are the Eustachian tubes which serve as the connection between the throat and the ears. On account of this connection, when we have a cold, our ears feel as though they were stopped up. So, too, if there is an irritation in the nose and throat, germs may travel through the Eustachian tubes and cause trouble in the ears, such as earaches or even abscesses. Whenever the Eustachian tubes become blocked, it makes the anatomy of the ear abnormal and the probability of infection becomes increasingly likely. As a matter of fact deafness, which rarely starts out in a very acute fashion, may result from such an infection. Deafness is the end result of chronic troubles with the nose and throat since the chances always favor the eventual extension to the ears.

Hygiene of the Ear. The hygiene of the external ear may be summed up by saying that absolutely nothing should ever be inserted in it. Wax, caused by the sebaceous glands, and, apparently, a natural thing, is always present in the external ear. This wax may interfere with hearing, but it should only be removed by an expert. In general, the presence of a normal nose and throat free from infections is the best insurance of sound ears and good hearing.

The Sinuses. In the face and head are several bony structures which contain air and are connected with the nose and throat. The chief function of these structures is to increase resonance. Above the eyes are the frontal sinuses; the antrum of Highmore is on either side of the nose and helps to make up the cheek bone, and the ethnoid and sphenoid cells are also in close proximity to the nose. The mastoid cells are connected with the internal ear and make up a bony prominence behind the external ear. All these structures may be diseased by the simple direct extension of infection. Mastoid infection may be extremely serious on account of the close proximity to the brain. Infection of the frontal sinuses is not uncommon and is the cause of troublesome headaches.

Catarrh. No word is more commonly used in connection with diseases of the nose and throat than the word catarrh. As a matter of fact catarrh is a symptom and not a disease in itself. It simply means that the mucous membrane of the nose and throat is not normal. Climates with sudden changes often cause catarrh. Occupations may also cause it. A man working in a quarry, for example, breathes in dust and the chances are that he will get catarrh as an expression of irritation of the mucous membrane. Smoking also increases the irritation of the nose and throat. As a result the person who smokes too much must be prepared to put up with this irritation.

On account of the inevitable close proximity of people necessitated by modern life, it is impossible to insure complete freedom from air-borne diseases. The individual can do much by the exercise of personal precautions, particularly when he is infected. Furthermore, sound general hygiene of the body and the correction of abnormalities of the upper air passages and the avoidance of irritation are of great assistance in

increased resistance and in eliminating footholds for lurking bacteria. The promiscuous use of gargles and nasal douches is not to be recommended, since the antiseptic power is necessarily slight. Most substances sufficiently powerful to kill bacteria also irritate and usually damage the tissues. Washing the throat with bland substances like water (gargling) is usually harmless and often beneficial in the event of infection. Uncommonly gargling, but frequently washing the nose (douching), serves to spread the infection. Since colds, as are many of the infections of the upper air passages, are definitely limited diseases, any measures except those directed towards general hygiene should be undertaken only on expert advice.

CHAPTER IX

The Hygiene of the Mind and Nervous System

The Nervous System and Disease. In considering the nervous system it is important to realize that the same food which nourishes the muscles also nourishes the brain and nervous system. Both the muscles and the nervous system are built up in the same way. The nervous and mental systems are poisoned in the same way as any other system in the body is poisoned. Like the other organs, the nerves and brain share in general poisonings and, likewise, are peculiarly susceptible to certain poisons. We see them, for example, becoming abnormal and poisoned in many of the contagious diseases. We have the temporary delirium in the course of typhoid fever, for instance, and also in the course of many other fevers. We are all familiar with the fact that a person is weak, both mentally and physically, after an illness, and especially after an illness associated with delirium. After some diseases, actual insanity may ensue. Excessive fatigue may also cause delirium.

Certain poisons, as alcohol, lead, morphine, cocaine, and the like have a particularly selective damaging effect on the mind and nervous system. The delirium of alcoholic intoxication is entirely mental, and the same is true of cocaine and morphine poisoning. Twelve per cent of all the first admissions to insane hospitals are due to poisoning by alcohol. Their minds were disturbed through the effects of

alcohol and these effects may be more or less permanent. All drug habitués have wrought serious damage to the mind and nervous system.

Even more important in its effects upon the mental and nervous systems is the disease syphilis. More than thirteen per cent of the first admissions to institutions for the insane are due to syphilis. The chances of recovery in the case of syphilitics are not so good as in the case of alcohol. With an alcoholic it is possible to purge the system of poison and build up the body again. On the other hand, in syphilis, while a certain number are curable, by the time the disease strikes the nervous system a large number of cases are incurable because changes have actually taken place in the brain and nervous system.

Injuries. Traumatic injuries to the head may cause serious damage to the mental faculties, although the seriousness and nature of the damage depend upon the localization of the injury. It is often remarkable that the injury and subsequent loss of considerable brain tissue in certain regions is accompanied by no serious loss of mental faculty or nervous function. A slight injury in another situation may cause death or the most serious damage.

Inheritance and Mental Disease. Heredity is easily the most important single factor in the problem of mental and nervous disturbances. Certain forms of insanity are largely determined by heredity. Feeblemindedness is almost exclusively hereditary. Then, too, the widely varying grades of mental and nervous irritability and instability are usually inherited. In such instances the individual environment, which includes nutrition, training, education, as well as the immediate surrounding influences of poverty, work, worry, and fatigue determine the ultimate condition of the mind and nervous system.

"**Stress of Life.**" An important factor in mental hygiene is the so-called stress of life. There are many people who maintain their mental and nervous equilibrium under the sedative influences of a perfectly normal and quiet life, but who, under different conditions, will go insane. Such people are always potentially insane, but the disease will not manifest itself until conditions of life are changed. This condition has been particularly apparent in the case of immigrants who have completely changed their habits and methods of living. Any taint of insanity or mental or nervous instability due to heredity is apt to come out under the stress of life. But a sound and average person, with a sound heredity, will undergo the most tremendous changes in environment without disturbing his mental or nervous poise.

The economic state of an individual plays a considerable part in the problem of mental and nervous hygiene. Only the rugged can withstand with equanimity the attendant ills and struggles of poverty. On the contrary, the wealthy man with a bad heredity can purchase unhygienic excess and increase his liability to his inherited tendency. The two economic extremes often produce the same results.

Perhaps the most important asset in mental and nervous hygiene is the cultivation of sound habits. Good habits will compensate greatly not only for bad inherited tendencies and poor environment but also for the almost inevitable stress and strain of modern life, for in this way we can control the evil effects of fatigue. In the same way we can combat all the evils of our economic conditions, whether that condition be one of prosperity or of poverty. All the discussions of mind and nerve cures preach the same doctrine, and many have recently emphasized the futility and absurdity of unnecessary worry. Fatigue and worry are integral

parts of the same vicious circle, which must be interrupted if possible. The work cure, the recreation cure, the rest cure, the self-forgetting cure, all turn on an appreciation and utilization of the fundamental principles of hygiene and the related factors of rest, work, and fatigue.

CHAPTER X

The Communicable Diseases

Early History of Communicable Diseases. Our environment surrounds us with many dangers which tend to shorten life, interfere with our health, and destroy our happiness. By far the most important of these dangers are the communicable diseases. The danger from communicable diseases is ever present; it may lurk in the air we breathe, in the food and drink we take, on whatever or whomever we touch, or from the bites of insects and animals. By a communicable disease we mean a disease which may be communicated, directly or indirectly, from person to person. Through loose usage the words communciable, infectious, contagious, and "catching" as applied to diseases are essentially synonymous. But by the use of the preferable term, communicable, we do not commit ourselves to the method of transfer of the disease or to the nature of the disease.

That some diseases at least were communicated or were "catching" has been believed since the earliest times. The common people early convinced themselves of this fact, while the so-called scientists were wrangling over the spontaneous generation of disease or arguing whether or not disease represented a visitation of Providence. The Old Testament tells us of the fixed belief that the leper was dangerous to the touch. Hippocrates insisted that many diseases were communicated from person to person, and mentioned smallpox in

the list. DeFoe, in his account of the plague in London, tells us of the well-defined and well-grounded belief that the disease could be communicated. Indeed tradition and history are full of accounts of plagues and epidemics from which the survivors, certain of the communicable nature of the pestilence, sought safety in flight.

While the belief that some diseases at least were communicated by touch or other method was fairly firmly established, the exact causative agents remained unknown until recent years. The most fanciful theories and the wildest superstitions sprang up concerning the immediate causes of communicable diseases. Jenner's discovery of the protective value of cowpox against smallpox, at the end of the eighteenth century, was founded on empirical grounds and did not directly aid in the solution of the mystery. Bacteria were observed as early as 1673. In 1762 we find the recorded doctrine which ascribed to every disease its particular micro-organism. But such ideas were isolated and escaped general attention. In 1843, Oliver Wendell Holmes, by brilliant reasoning, suggested that puerperal fever (childbed fever) was a communicable disease and was probably transferred by doctors and nurses. The conservative medical profession fairly skrieked its indignation and bitterly attacked Holmes and his theory. The result was a masterpiece, in both the literary and scientific sense, from the pen of Holmes. In the meantime modern medical science was being born.

The Work of Pasteur. Enormous progress had been made in physics, chemistry, physiology, and the allied sciences. In 1858 the publication of Virchow's cellular pathology placed the study of disease on a firm foundation. Accurate instruments of investigation, chief among them the microscope, were being developed. Then came Louis Pasteur (1822–1895); the father of

bacteriology. In view of his achievements in the field of medicine it is remarkable to relate that Pasteur was educated as a chemist. In the investigation of all his problems he applied scientific and laboratory methods. In 1860 occurred a famous controversy concerning spontaneous generation. The supporters of this theory maintained that the cloudiness of beer, wine, and of clear broths was due to the development of certain substances *de novo*. Pasteur and his adherents claimed that such fluids were contaminated from the vessel or from the air, and that this contamination was caused by the growth of minute microscopic particles, the "infinitesimally small." Pasteur also showed that the heating of such fluids (subsequently known as pasteurization) stopped the development of the contamination. He took the precious flasks which he used in his experiments to the Alps and opened them there to demonstrate that the pure air of the mountains, free from human contamination, contained fewer of these minute particles.

The first great work of Pasteur concerned itself with industrial diseases. He showed that the various fermentations were due to the presence and growth of minute organisms and that the spoiling of beer and wine, for instance, could be prevented by heating them at a low temperature (pasteurization). The heating prevented the growth of the minute particles but did not affect the taste. He then began to recognize and to grow in artificial media these minute particles, micro-organisms, microbes, or germs. The next step in Pasteur's work in bacteriology was to attribute the cause of many diseases to these germs, with the result that from 1870–1890 people said as now, "This microbe business is getting to be a joke. Do they want us to believe that everything is caused by a microbe?" But in 1877–1879 Pasteur was able, by

a dramatic series of incidents, to demonstrate that the dreaded charbon of cattle (anthrax), which was devastating France and had cost millions of francs, was caused by one of these microbes and, furthermore, he was able successfully to vaccinate against it. By the knowledge that Pasteur gained from his study of the infecting organism, he was able to suggest preventive measures which eradicated the disease. From that time on the causative agent of one communicable disease after another was discovered. Pasteur lived to see the discovery by one of his pupils of diphtheria antitoxin in 1894, after the diphtheria bacillus had been discovered by others.

In 1881 Koch, in Germany, published his work announcing not only the discovery of the tubercle bacillus, the causative agent of tuberculosis, but also all the important facts concerning that micro-organism. In England, Lister utilized these discoveries, especially those of Pasteur, and thus modern surgery began. Pasteur first saw clearly the rôle of micro-organisms in the cause of disease. He studied their life and habits. He promulgated the important doctrine of vaccination against disease. He developed the cure of disease by antitoxin. In the brief span of one life the conception of communicable diseases changed from that of the visitation of the mysterious agencies of the Evil One to the effects of infection by a definite micro-organism that could be combated.

We have learned that many diseases, childbed fever for example, not commonly thought to be communicable, are positively caused by micro-organisms. While, since earliest times, a few supposed fanatics had claimed that consumption was communicable, the general belief had been that it was either hereditary or a "visitation", until the truly epoch-making discovery of Koch cleared up for all time the mystery of its causa-

tion. By bacteriological research it was learned that apparently different disease appearances were only different manifestations of the same micro-organism. Thus bacteriology violently disarranged all the previous concepts of disease. It was the appreciation of these discoveries in bacteriology that made modern surgery possible, that made child birth relatively safe, and has given us a considerable part of the knowledge necessary to fight communicable disease.

As yet not all the infinitesimally small agencies which cause disease have been discovered. We do not know the precise micro-organisms which cause yellow fever, measles, and some other diseases. We do not know how leprosy and anterior poliomyelitis (infantile paralysis) are spread. Although each year adds to our knowledge, increased knowledge is still necessary, as diseases are preventable only in proportion to what we know of them.

Exact and complete knowledge is essential to the fighting of disease, and particularly so in the case of the communicable diseases. In order to undertake the prevention of a communicable disease with some assurance of success, it is necessary to know the cause, the life history of the micro-organism, how it is transferred, and the cure of the disease. Yet the application of reasonably adequate knowledge may be extremely difficult for a variety of reasons. In syphilis, for example, we have a complete knowledge of the cause of the disease; we known exactly how it is carried; we can recognize the germ, and we have a satisfactory treatment in that it will practically cure all cases, but we cannot eradicate the disease. The personal element is so great a factor in syphilis that we are absolutely unable to prevent the social conditions that favor the transmission of the disease. Tuberculosis is in theory preventable, but, practically, the nature of the disease

is such that it is difficult of prevention. On the other hand in some diseases while we know much about them, even how to prevent them, we do not know the cause. Yellow fever, for example, is always transmitted by the bite of a particular mosquito and we know how to prevent the disease without knowing the causative micro-organism. Again we do not know the organism which causes smallpox, yet we can protect entirely against this disease by vaccination. While the prevention of disease depends upon our knowledge of it, it is significant that a little knowledge will enable us to prevent one disease, while an extensive knowledge may not always suffice for the prevention of another disease with peculiar characteristics.

The great, outstanding fact concerning all the communicable diseases is that the causative agents are minute forms of life, both animal and vegetable. Their size varies from ultra-microscopic, that is, so small that these forms of life cannot be seen by the magnification of our microscopes, to certain animal forms, like some of the worms, which are readily visible to the naked eye. Even in the case of the large animal forms the infection is usually transferred by means of eggs which are microscopic. Thus, in general, we refer in a somewhat loose way to micro-organisms or microbes, meaning merely the minute forms of life, either vegetable or animal, of which a certain proportion are associated with disease.

Classification of Micro-organisms. There are, of course, many possible divisions and subdivisions of these micro-organisms according to their many characteristics. A reasonably satisfactory classification is to divide them into three groups: (1) the bacteria, which, in a loose terminology, includes all forms of vegetable micro-organisms; (2) the protozoa or the simple animal micro-organisms; (3) and the metazoa

or higher and more complicated forms of animal life, as the worms. Such a classification depends upon the structure of the micro-organism and not upon its relation to disease. Only a comparatively small proportion of the minute forms of animal and vegetable life are hostile to man and cause disease. The presence or absence of micro-organisms is not the essential feature. Whether the micro-organism is pathogenic to man is the vitally important line of differentiation.

The Bacteria. Bacteria are minute vegetable particles which can only be seen through a microscope. Some fifteen hundred kinds of bacteria have been described and others are being discovered constantly. Bacteria are present everywhere, — in the air, in water, in the soil, and throughout Nature.

But not all bacteria are harmful. For example, bacteria perform such useful purposes as giving flavor to cheese and buttermilk. Fermentation is usually a bacterial action. Plant and animal life would disappear without bacteria, for it is largely bacterial action that prepares food for vegetable life and growth as is well seen in the nitrogen and carbon cycle.

We can, therefore, divide the bacteria into two classes — the pathogenic, which cause disease, and the non-pathogenic, which are harmless or semi-beneficial. This, however, is not always a definite distinction, for a bacterium non-pathogenic in one situation may become pathogenic in another. Our intestines, for example, contain many forms of bacteria which are non-pathogenic, but which, if placed under the skin, would be pathogenic.

Bacteria may be subdivided into several groups, depending on their morphology. The small round forms are called cocci or micrococci. In addition to having differences in activity and in causing different diseases, these micrococci have definite characteristics

of morphology and growth. Thus we speak of the micrococcus of pneumonia, the pneumococcus, the micrococcus of gonorrhea, the gonococcus, and the micrococcus which is the common pus maker, the staphylococcus, or to give the full name the staphylococcus pyogenes aureus.

The bacilli are the various rod-like forms of bacteria. The bacillus group is, perhaps, the most important from the viewpoint of disease, as it includes the typhoid bacillus, the tubercle bacillus (the micro-organism of consumption), the diphtheria bacillus, and the like.

A spirillus is merely a twisted rod. An example in disease is the spirillum of Asiatic cholera.

A spirochæta is a rod which appears in twists like a corkscrew. Some observers prefer to classify the spirochætæ as an animal form of life. Many spirochætæ, however, grow like vegetable forms. The most notable example of the spirochætæ is the spirochæta pallida of syphilis or, more accurately, treponema.

Some of the higher and more complicated forms of vegetable life, the fungi or molds, occasionally cause disease. We may loosely include here such causative agents as the tinea of "ring-worm" and the actinomyces which cause actinomycosis.

With the perfection of our technical methods, it is probable that other groups will have to be added, since there is every reason to believe that measles, yellow fever, and scarlet fever are caused by some form of bacterial life, although we are not yet able to discover the causative agent. Apparently some of these causative agents are so minute as to baffle discovery by our present microscopes. These ultra-microscopic forms of micro-organism, presumably bacteria, may represent additional types of bacteria.

The Protozoa and Metazoa. The second large group of infecting agents is the group of small animals

— the protozoa. These are simple, one-celled animals, of which the simplest form is the amœba. A few of the amœbæ are pathogenic. Malaria is caused by a protozoön. The trypanosome that causes sleeping sickness is a form of protozoa.

The third group of infecting agents is that of the metazoa and includes the various worms, — the tape-worms, the pin-worm, hook-worm, trichinæ, and the like.

Characteristics of Bacteria. Since they cause most of the communicable diseases, the members of the bacterial group are the most important. Bacteria have no one essential characteristic. Some are extremely motile, as the typhoid bacillus, while some reproduce rapidly and others slowly. A typhoid bacillus will grow large numbers overnight, while it takes a week to get a considerable growth of the tubercle bacillus. Then certain forms, known as the anaerobes, will not live in the presence of oxygen, while others, the aerobes, will live only in the presence of oxygen. Others grow easily with or without oxygen.

Certain of the bacteria, such as the anthrax bacillus, produce spores, — which is a form of hibernation. The spore is a small capsulated object in which the organism seems to hibernate. Spores are difficult to kill and it may require boiling for a long time to accomplish this.

In general, bacteria reproduce rapidly and the average bacterium will reproduce in about half an hour. This is accomplished by division or fission, provided favorable conditions are present.

Just as some bacteria prefer oxygen and some do not, each form of bacteria has certain peculiarities of growth both within and without the body. Some bacteria grow easily in any organ or anywhere that they can find nourishment. Others will only grow in certain organs within the body and under special conditions outside.

All bacteria require food, although the requirements vary widely. In general the pathogenic bacteria thrive best at a temperature approximately that of the body (37.5° C. or 98.4° F.). Also bacteria like moisture and darkness. By reversing these conditions we can hinder or prevent bacterial growth. As we cultivate bacteria in a dark thermostat on a moist media, so we prevent their growth outside by exposure to light, by cold or heat, by dryness, and by the absence of suitable food. Outside of the body, in addition, we make use of the various more positive methods which actually destroy the bacteria rather than inhibit their growth.

The Destruction of Bacteria Outside the Body. At first thought it might seem possible to kill all the pathogenic bacteria wherever they exist. But it must be remembered that the non-pathogenic bacteria are necessary for life and that we cannot always distinguish definitely between pathogenic and non-pathogenic bacteria. There are a number of means of killing bacteria. As surgery began, for example, there was a wide use of disinfectants. Lister performed his operations in the midst of a carbolic acid spray which was supposed to kill all the bacteria in the operating field and in the surrounding air. But a continued use of these disinfectants has proven unsatisfactory. Bacteria must be regarded as a form of life, and the use of disinfectants which kill bacterial life will also destroy other kinds of life. The use of disinfectants will, for instance, tend to kill the cells of the hands, while it is almost impossible to use disinfectants in the throat without killing the cells of some of the delicate membranes. But in their place disinfectants play an important and necessary rôle.

Three main methods are in use against bacteria. First, we use the physical properties which Nature provides, as light and heat. Most bacteria prefer

darkness and some bacteria cannot live at all in the presence of sunlight. A combination of sunlight and sunheat is an admirable, though slow, method of destroying bacteria. The violet ray kills bacteria promptly. Sufficient heat will kill all forms of life. Pasteur early found that heating at 60° C. (144° F.) for half an hour killed most of the ordinary forms of bacteria. Heat may be used directly or as dry heat or moist heat, often under pressure, or in boiling. But, obviously, there are many things which we desire to free from bacteria, such as books, which cannot be subjected to heat without destroying the article itself. Boiling, as in the case of surgical instruments, is, perhaps, the best method of killing bacteria. Boiling for a limited period will kill all known bacteria. Moist heat under pressure is very effective and is the method of choice for sterilizing clothes, surgical dressings, and the like.

The second group of agents used to kill bacteria is comprised of the chemicals, which are usually employed in the form of a liquid or of a gas. Few chemical disinfectants can be used about the human body in sufficient concentration to be really effective. Carbolic acid is the oldest disinfectant. The salts of mercury (bichloride of mercury or corrosive sublimate), although valuable disinfectants, have the disadvantage that they corrode metals. They also form inert and insoluble compounds with albuminous matter, such as blood and pus. Finally, they are extremely poisonous, as the toll of deaths from the accidental or intentional taking of corrosive sublimate shows. The most modern chemical disinfectant is formalin, a solution of formaldehyde gas. This is an admirable disinfectant and can be used where a large number of others are impossible or useless. Lime, either in the form of chloride of lime or quick lime, has been known as a disinfectant for many

years. It is widely used as a disinfectant of feces, sewage, and garbage and is cheap. It should always be freshly prepared. Alcohol is one of the best disinfecting agents which we have. It can be used on the skin, for example, without injury to the tissues.

All the acids are powerful disinfectants, but they are not employed extensively on account of their general destructive properties. There are, of course, many other liquid disinfectants and various modifications of those mentioned, especially of carbolic acid (phenol).

Two disinfectants, which are not active on bacteria in general but which are very effective for special use, are sulphate of copper and chlorine. Sulphate of copper, in a weak solution, is used in water and swimming pools to destroy the algæ and many bacteria. Unfortunately in such solution sulphate of copper has little or no effect on the typhoid bacillus. Chlorine as such or as bleaching powder, when added to water, will kill bacteria in such dilution that the taste of the water is hardly affected.

The value of all the liquid disinfectants depends on the complete immersion of the article to be disinfected, for in no other way is penetration obtained. It is evident that air cannot be disinfected in this way, and that, as a rule, neither can a room.

Fumigation. From time immemorial substances in the form of gas have been used as disinfectants. This procedure is termed fumigation. In point of fact the value of most of these substances, usually created by burning, was to act as a deodorant or to overwhelm the original disagreeable odor by another more pungent. The actual disinfecting power of most of these gases is slight. The use of sulphur as a true disinfectant has been discontinued. While sulphur is extremely effective in killing mosquitoes and other insects, it does not kill bacteria except in the presence of moisture.

Formaldehyde gas, however, under suitable conditions is extremely efficient. It is, at present, the usual method applied to the disinfection of rooms and houses. There are a number of devices for the production or liberation of formaldehyde gas. This gas must be used at a temperature of 65° F. or higher and with an initial humidity of sixty-five per cent. A skilled person must be employed to disinfect with this gas for it must be confined within the room to be disinfected and the creation of a disagreeable odor is by no means synonymous with disinfection.

Indirect Methods of Controlling Bacteria. The third method of destruction of organisms is not a direct method, but works indirectly. By this method bacteria are denied entrance to their normal habitats where they multiply rapidly, and conditions are made so unsatisfactory and unfavorable for the bacteria that they die without any reproduction of their kind. Withholding all food is an excellent method of destroying bacteria. This method of the destruction of organisms requires the intelligent application of our knowledge of the habits of bacteria. By such means, for example, are we able to preserve food. Likewise we establish the principles of *asepsis* in surgery as opposed to antisepsis. By antisepsis we mean the killing off of bacteria; by asepsis, keeping the field free from bacteria. In other words, it is really more effective to prevent the entrance of bacteria than to kill them off after they have entered. The preparation of the hands for a surgical operation is a case in point. It is more effective to rid the hands of all dirt and bacteria and to encase them in clean rubber gloves than to apply antiseptics which will kill the bacteria and, perhaps, damage the hands. The action of soap and water is largely mechanical. The bacteria are washed off and are prevented from reaching places where they multiply rapidly.

This same principle is utilized in the care of both water and milk and in the treatment of sewage. The important consideration in the treatment of milk is the prevention of contamination of the milk, rather than the killing of the bacteria after their entrance. In the treatment of a water supply, water that is kept for a certain period of time and freed from substances which will feed bacteria becomes practically bacteria free. Sewage, which is put into dry earth where it cannot contaminate drinking water and thus re-enter the human body where the bacteria again multiply rapidly, will help to fertilize the land and the pathogenic bacteria will die out.

The Practical Use of Disinfectants. All of the three methods and modifications of these methods are utilized in everyday life. We can, perhaps, best illustrate by the problem of preventing the spread of infection from a patient with such a disease as typhoid fever.

The discharges of such a sick person, particularly the feces, contain dangerous typhoid micro-organisms. The sputum and nasal discharges may well be received on gauze or paper or in sputum cups and burnt. The most efficient chemicals for the disinfection of sputum are carbolic acid 5%, formalin 10%, and chlorinated lime 3%. The urine and feces should not be poured into a sewer that has an unknown outlet. The urine, uncontaminated with feces, which do not allow the proper admixture of chemical substances, can be disinfected by the same chemicals as the sputum. The non-fluid feces can be burnt, preferably in an incinerator. All chemicals used to disinfect feces should be allowed to stand in contact for at least an hour and sufficient quantities should be used. Lime is particularly valuable, but it should be remembered that air-slaked lime is inert. Lime and water in proportion of one to four, freshly mixed and in sufficient amount to cover and

thoroughly impregnate the material, are effective, if allowed to stand for two hours. Likewise an equal amount of 5% carbolic acid or 10% formalin will disinfect in about an hour.

Everything which touches the patient may be infected. Therefore all bed and body clothes, towels, napkins, and the like should be boiled. They may be immersed in carbolic acid 5%, formalin 10%, or bichloride of mercury (corrosive sublimate) one to 1,000. Such clothing soiled by albuminous secretions, like blood and pus, will be stained permanently if boiled directly, and hence they may be first washed in cold water, which is then boiled or disinfected. Dishes should be treated with boiling water.

While disinfection of the room is not necessary in the case of typhoid as it is in the case of the air-borne infections, as smallpox, it is often desirable to treat the room. All articles in the room which can be treated by heat, either moist heat under pressure or dry heat, or boiling are so treated. Any useless articles can be burned. The room is then treated to gaseous disinfection by the selected method. Formaldehyde disinfection is the most generally useful. The experienced handler of this disinfectant will see to it that a sufficient amount of gas is liberated, that the outlets of the room are effectively closed, and that the materials in the room are so managed that the gas can penetrate and disinfect.

Carpets, rugs, and the like are often not thoroughly disinfected by formaldehyde gas and it is desirable that they should be removed subsequently and subjected to moist heat. In some instances saturation with formalin solution will suffice. Again, exposure to strong sunlight will act effectively. Books are not common carriers of disease despite the impression to the contrary. Thoroughly contaminated books should be burnt. On the other hand, books merely present

in the room are rendered harmless by cleansing. In addition, there are several special disinfecting devices for contaminated books.

In addition to these precautions, after the disinfection a thorough mechanical cleaning and a prolonged exposure to sun and air are eminently desirable. In the case of measles and whooping cough, in which we know that the infecting agents are only transmitted by immediate contact, these latter precautions amply suffice. In point of fact we are learning constantly that most bacteria, away from a favorable resting place, such as soil, water, milk, feces, and the human body, do not exist for any length of time and that, with the removal of such substances by simple cleanliness, the danger of communication is, in most instances, extremely slight after the lapse of such a period of time as a few days. There is an increasing tendency to discontinue terminal infection by chemical means and to concentrate on thorough mechanical cleansing.

The human element is the chief communicating one and is difficult of disinfection. By the intelligent appreciation of what carries infection and what does not and by scrupulous cleanliness, there is little danger. In these days doctors rarely carry infection, although passing from patient to patient. In the first place the doctor touches as little contaminated material as possible. In many instances he wears a gown and gloves in the sick room. After his visit he washes his hands, thoroughly. While nurses and doctors contract typhoid through the handling of patients, it is on account of carelessness, but not always on the part of the victim. In the case of air-borne infections, the danger is greater and the protection is less. Still, by avoiding close proximity to the patient and, particularly, his breathing, with the coöperation of the patient the danger of infection is greatly lessened.

The Destruction of Bacteria within the Body. It might be thought that when bacteria get into the body they would tend to grow until the infected person died. The doctrine of the self-limitation of disease has been accepted only comparatively recently. All diseases are not self-limited. But we are familiar with what is known as the typical course of a disease, which is uninfluenced by treatment. Measles runs a definite course of a few days and typhoid of a few weeks, yet the exact mechanism that brings about this limitation of disease and a spontaneous cure is not well understood.

The outcome of disease may be considered to depend upon three factors: the number of bacteria in the initial dose; the virulence of the bacteria, and the resistance of the body.

To a considerable extent, at least in some diseases, and well illustrated by certain experimental conditions in animals, the intensity of disease (and its outcome) depends on the number of bacteria entering the body. But this is not always true. We can speak more definitely on the question of virulence. The mortality statistics show that some epidemics are notoriously severe, while others are mild. This indicates that the infecting bacteria are not always of uniform virulence. At times this virulence is increased, and at times decreased. In the laboratory the virulence of a microorganism can occasionally be altered.

Resistance of the Individual to Infection. The most important fact in the intensity and the outcome of a disease is usually the resistance of the individual, — the natural immunity or the natural susceptibility and the antagonistic reaction of the individual's tissues against the disease. This resistance varies enormously. Certain persons are notoriously susceptible to all forms of communicable diseases; others seem to be

immune. So, also, do people vary after the disease has been contracted, — some offer little resistance, while others offer the most stubborn resistance to the onslaught of the particular disease. We see in the different animals perhaps the widest variations in resistance. Typhoid fever is peculiarly a disease of man and cannot be given to animals. Certain kinds of mice are susceptible to the pneumococcus, while others are practically immune. There are some diseases which the body apparently does not resist at all, as the pneumonic plague, which seems to be always fatal.

We know little positively concerning the mechanism of resistance and the defense of the body. If a person has smallpox or yellow fever and has recovered, he is generally immune from the disease and will never contract it again. This is known as acquired immunity as contrasted with natural immunity. There is a definite tendency for one attack of many diseases to protect against other attacks. The application of this is the underlying factor in vaccination, for vaccination, whether against smallpox, typhoid, or anthrax, merely consists in giving the individual, by means of an attenuated or modified virus, a mild form of the disease and thus affording him, in part at least, the protection that an attack of the disease would give.

In certain diseases one attack does not protect against another. In pneumonia, one attack seems to render the individual more liable to a second attack. In point of fact one attack does afford protection, but this lasts for but a short time. When the protection is lost, the mechanical damage to the lungs favors a subsequent attack. The same holds true of colds, rheumatic fever, diphtheria, and gonorrhea. Since the attack of the disease does not afford protection, it is evident that vaccination, from its very nature, can accomplish nothing against these particular diseases.

Some individuals are naturally protected against certain diseases, as diphtheria, for instance. There is something in their blood which opposes the growth of the bacillus at its entrance. This seems to be more or less a slowly acquired racial and hereditary characteristic. With us measles is a mild disease, but the people of the South Sea Islands were killed off right and left by an epidemic of the disease. The conclusion is, that because we have had measles for so many years, a certain degree of protection is hereditary. So the early ravages of syphilis in Europe were more severe than those of to-day.

From time to time we have believed that we knew how this protection worked. But the theory of phagocytosis, for example, that the bacteria which come into the body are fought and eaten by the white cells of the blood, by no means entirely explains resistance. We now presuppose the existence in the blood of certain theoretical substances, not demonstrable chemically, but often demonstrable biologically (that is by their activity in various ways against the particular micro-organism) which we designate as anti-bodies. We presuppose and can demonstrate biologically a different set of anti-bodies for each micro-organism. Ehrlich has brilliantly outlined this doctrine in his side-chain theory of immunity.

After bacteria gain an entrance into the body, they can act in one of two ways. They can act through their own presence or through a poison which all bacteria elaborate and which is known as a toxin. This toxin may be widely diffused, or it may remain inside the bacteria themselves. There may be one or more toxins. Both bacteria and toxins irritate the tissues of the body.

Bacterial Toxins or Poisons. The baneful effects of bacteria are due, in a general way, to the toxins

elaborated by them. These toxins are not demonstrable chemically, but they seem to be substances similar to the snake venoms. Again in a general way, the toxins of bacteria are highly poisonous and reproduce the general picture of the disease. A characteristic of toxins is that if they are injected into animals, antitoxins are produced. There is considerable evidence that some of the activity of the toxins is attributable to the medium in which the bacteria grow. Theoretically at least, it is evident that in resisting disease two or more substances antagonistic to bacteria must be developed. One substance — antitoxin — will neutralize the toxin which may be causing the damage at a considerable distance from the growing bacteria. We have a beautiful illustration of this in the use of the diphtheria antitoxin. Antitoxin occurs most abundantly in the blood stream, but it is also present in the fixed tissues. The chemical nature is unknown beyond the fact that it is a protein substance, a globulin or attached to the globulins. Another substance will attack the bacteria themselves, a true bactericidal agent. It seems probable that the development of these substances, while not precisely parallel, tends to be more or less so. In the spontaneous cure of disease these substances antagonistic to bacteria and their products are developed sufficiently to eradicate the disease. In some diseases the body retains a sufficient supply of these antagonistic substances to afford immunity for life. In other diseases this immunity is short lived.

Antitoxins. Since the discovery of bacteria and the beginning of knowledge concerning their methods of action, medical science has been endeavoring to secure, by artificial means, antagonistic substances which will act in the same curative fashion as the natural products. Vaccination is merely the creation of the natural antag-

onistic substances induced by an intentional innocuous modification of the disease. The dream of medical science has been to manufacture these natural products in the test tube, but so far this dream has not been realized. In the case of certain bacteria, — most notably diphtheria, tetanus, and a few others — which have certain peculiarities so that they lend themselves particularly for this purpose, — these antagonistic properties have been secured in marked concentration in the blood of animals, — usually horses. The use of the acquired antitoxin in human beings is hardly feasible as it would require the use of too large an amount of blood to afford adequate antagonistic substances. Horses, however, can be so highly immunized that a small portion of the blood serum (the residual fluid after the clotting of blood) contains sufficient antitoxin to counteract all the toxins in the entire human body. Since toxins and antitoxins are usually inert when given by the mouth, the horse serum which contains the antitoxin must be administered either under the skin or into a vein. Unfortunately, so far, we have not been able to develop antitoxins for many bacteria. The antitoxin may be used to prevent as well as to cure disease. The effects of antitoxins are transitory, lasting in the case of diphtheria only from two to six weeks. The antitoxin created for one disease acts only against the toxin of that disease.

Bactericidal Substances. In addition to endeavoring to produce antitoxin, scientists have labored to produce bactericidal substances. Antimeningitis serum, which has been highly successful, probably acts more in antagonizing the bacteria and the contained products than in antagonizing the doubtful diffusible toxin of the meningococcus. But at present medical research is turning more to chemical substances than to biological substances in the hope of obtaining bactericidal agents.

It has long been known that quinine, for example, would kill certain animal parasites, but that it did not seriously affect the body tissues. The ordinary disinfectants, however, cannot be used to kill microorganisms in the body, since they destroy the body cells as well as the infecting agents. The painstaking labors of Ehrlich gave us Salvarsan, a substance that has a destructive affinity for the spirochætæ of syphilis, but which, as a rule, does not injure the body. The spirochætæ are an unusual form of bacteria and are probably more related to the animal parasites. Still a beginning has been made and such chemotherapy promises much for the future. Of much less importance, but still of significance, is the earlier discovery that formaldehyde in certain combinations, such as the patented urotropin, could be taken into the body and the formaldehyde liberated and thus act as a disinfectant. Thus, under favorable conditions, some bacteria which infect the kidney and bladder are killed.

While we do possess certain antagonistic substances which act in a remarkably effective manner, like diphtheria antitoxin, antimeningitis serum, and Salvarsan, in most instances of bacterial disease we are thrown back on the natural creation of resistance. We have learned that insufficient and improper food, excessive fatigue from any cause, alcoholism and other poisonings, and, in fact, any misuse of the body or its functions carry with them the penalty of reduced resistance to communicable disease. Poverty with its attendant ills can be demonstrated to increase the susceptibility to disease. The greatest natural resistance to communicable diseases is found in the maintenance of health through the exercise of the principles of sound hygiene.

Methods of Spread of Communicable Disease. The prevention of disease, and especially of the communicable diseases, is so manifestly desirable as to be self-

evident. As we have seen, we are able at present to guarantee a cure in few of the communicable diseases. Of course, in most instances, the victim of such diseases recovers, but this is largely due to the natural forces of the body and only in a slight measure to specific treatment. Furthermore, since from their nature communicable diseases do not originate *de novo*, but are transferred from one person to another, either directly or indirectly, each case of such a disease represents an additional focus with the manifold possibilities of further dissemination of disease. With few exceptions the primary focus of communicable disease is man, for the infected man is the starting point for the spread of such infections.

In order effectually to prevent the spread of disease, it is necessary to know as much as possible about the habits of the infecting micro-organisms, for the prevention of communicable disease depends primarily on the knowledge of the methods by which that disease is communicated from person to person. Prevention is successful only in proportion to the completeness of the interruption of the line of communication. Theoretically all communicable diseases are preventable, but practically we find it difficult to interrupt the line of communication in some diseases. In other diseases, where we do not know the method of dissemination, we work blindly and, consequently, ineffectually.

Obviously the method of communication of disease determines the method of prevention. For example, as long as yellow fever was considered a filth disease and spread through the human secretions or by contact, the most elaborate precautions had no effect on its spread for it is carried only by a mosquito.

The manner in which communicable diseases are transferred from person to person and gain entrance to the body gives us a working classification of these

diseases. No classification is entirely satisfactory. In many instances usage has given a new meaning to words which, from their derivation, mean something quite different. The words " contact ", "contagion ", and " contagious " afford a good illustration. Contact originally meant touch. Yet we speak of contact cases of diphtheria, merely meaning rather directly from one person to another through the air. We speak of contact cases of typhoid, meaning that persons handling typhoid discharges, not necessarily touching the patient, have contracted the disease. We also speak of indirect contact. Contagious is now used fairly generally as synonynous with communicable.

The communicable diseases may be divided roughly into five classes: (1) those that are ingested and enter the body through the digestive tract, usually in connection with food and drink, — the method of ingestion; (2) those that are spread in the air, usually in the form of droplets, and enter the body through the air passages, the air-borne diseases; (3) those that are spread by contact and gain entrance at the site of the inoculation through the skin; (4) those that are spread by insects, and (5) those whose manner of gaining entrance to the body is unknown. When a disease is spread by only one method, which is the general rule, our preventive precautions need only be directed against that line of communication. But some diseases are spread by more than one method and this necessitates various precautions. Quarantine and isolation merely signify that the necessary precautions are being taken for the prevention of the communication of some particular disease and must obviously vary with each disease.

Considerable confusion inevitably results from the use of any classification. It is necessary to emphasize that bacteria locked up in an infected person are inocuous to others. Disease is spread when bacteria have

a means of escape. Consequently the nature of the disease, the avenues afforded the bacteria to escape, the number of bacteria that so escape from the diseased persons plus the viability of the bacteria in the particular medium, usually a secretion or discharge, under the given conditions determine how infectious a diseased person — the bacteria carrier — is. So it follows naturally that all diseases are not equally communicable even within any group and some knowledge of the various diseases is necessary to prevent their spread.

CHAPTER XI

Diseases Transmitted by Ingestion

Typhoid Fever

Prevalence of Typhoid Fever. First in importance among the diseases caused by ingestion is typhoid fever. This disease ranks fourth in causing deaths in the United States, being exceeded only by tuberculosis, pneumonia, and cancer. Bright's disease, diarrhea and enteritis, apoplexy, and arterial disease, all cause more deaths than typhoid fever, but these conditions must be regarded as disease groups and not as single diseases. In 1914, typhoid, diabetes, and diphtheria, including croup, all caused about the same number of deaths. The same statistics show a gratifying decrease of fifty-seven per cent over the figures for the year 1900. Nevertheless there is still more typhoid fever to-day per capita in the United States than there was ten years ago in Germany and England. Ten years ago the United States had several times as much typhoid as those countries in proportion to population. As typhoid is due almost entirely to neglect of sanitary conditions, which in a large measure could be prevented, the presence of this disease to the extent of over 150,000 cases with a mortality of 25,000 annually is a severe reflection upon our national methods of health protection. The incidence of typhoid fever in a community, as Sir William Osler pointed out, can be taken as the index of the sanitary intelligence of that community.

The name " typhoid fever " comes from the Greek word meaning stupor as does the word " typhus ", another disease characterized by stupor and which was long confused with typhoid. In fact, although typhoid fever has been known even from traditional times, it has been distinguished from typhus only recently. In 1829, Louis, of Paris, first emphasized a number of cardinal points of typhoid, but not until 1837 was the identification completed by Gerhard of Philadelphia. In 1880 Eberth isolated the bacillus of the disease and proved it to be the sole cause. So far it has been impossible to produce typhoid in animals.

Typhoid is found to some degree all over the world, but it is unduly prominent in the United States. It is the cause in the large majority of cases of continuous fevers of more than ten days' duration in the temperate zone. The disease has sometimes been called " slow " fever, and again it has been known by the name of the locality in which it existed, as Mediterranean fever.

Course of Typhoid Fever. In the course of typhoid fever, the bacillus is found in the blood and in the feces. It is usually easier to diagnose the disease from the blood. Another method of diagnosis depends upon a certain reaction in the blood — the Widal reaction. Widal found that a drop of blood from a person who has typhoid or who has had it recently, when mixed with the typhoid bacilli, will cause the bacilli to come together and will prevent their moving about. Obviously something has been developed in the blood which not only kills the bacilli but clumps them. Undoubtedly this phenomenon plays a large part in the protection against the disease. The blood of a person who has not had typhoid will not, in this blood test, show any effect on the bacilli.

One attack of typhoid protects reasonably for the

rest of one's life. There are, however, occasional cases where an individual has had typhoid more than once, but most of these cases are extremely doubtful and they hark back to the days when diagnoses were not accurate.

Much of the importance of typhoid fever is due to the fact that it attacks people in the bloom of life, a large percentage of the cases occurring between the ages of twenty-five and thirty. The disease is mild in children and old people, while it is more liable to be fatal in young adult life. The mortality varies under different conditions, but the average mortality is between eight and sixteen per cent.

Typhoid fever is a long fever and may last for months. When it has run its course, the patient is left extremely weak. In the United States Army the man who has typhoid is automatically given a six months' furlough to convalesce. So the importance of typhoid fever is not only that it kills so many people, but also that it is the cause of immense economic loss in that it carries with it such a long period of economic inactivity during the most productive years.

Typhoid fever is much more common in certain localities than in others. The cities along the Great Lakes and on rivers, as Philadelphia, have had severe epidemics of typhoid. On the other hand, typhoid fever is almost unknown in Germany, and the mortality in Berlin and Munich is almost nothing. In fact in all the large European cities typhoid is much less common than in the United States, although it is usually rather prevalent in Italy and Russia.

Typhoid fever is a so-called self-limited disease. Left to itself typhoid will run its course and a certain percentage of the cases will die. If the patient is not well cared for, the mortality will be high, perhaps as high as fifty per cent. The disease stops on account

of the natural protection of the body. There is as yet no real cure for typhoid, and, therefore, all our measures must be aimed at the prevention of the disease.

Transmission of Typhoid Fever. Since typhoid fever often occurs in epidemics of different origin, it is impossible to give accurate differentiating accounts of its transmission. All the excretions of the typhoid fever patient contain the typhoid bacilli and the spread of the disease is through the spread of these excreta. It is a conservative statement that forty per cent of the cases are due to contaminated water; twenty-five per cent to infected milk, and thirty per cent to contaminated substances put into the mouth, including those contaminated by fly transmission. But water is the great carrier of typhoid, — milk is often infected from water — and the number of typhoid cases is an excellent test of a city water supply.

Water may be contaminated in various ways. The essential fact is the mixture of sewage and water. On a small scale, we have the household well contaminated from the near-by privy. On a large scale we have the community water supply infected from the sewage of another community. In the early stages of the disease, a person is often ambulatory while having the bacteria in his stools, and, in fact, the exceptional case may be ambulatory throughout. Again, we know that a proportion of the recovered cases carry bacteria in their stools for years. These facts suggest how easily a water supply may be infected and how necessary, even in the apparent absence of disease, are good sanitary habits on the part of the individual and careful disposal of sewage and purification of the water supply on the part of the community.

Typhoid is also transmitted in food, and milk is the principal food which acts as a carrier of the disease.

This is due to the fact that as soon as the typhoid bacillus gets into milk, it finds a perfect medium for growth. If the temperature of the milk is kept low, the organisms will grow but slowly. This entrance of the typhoid bacillus into the milk may occur through water or through careless handling, but it usually enters in the water supply in washing out the cans and in similar operations. Cows never have typhoid fever, so it follows that the milk must be contaminated from human sources. When milk is contaminated, it carries the bacilli in large quantities, but epidemics due to milk are usually mild.

Oysters are also carriers of typhoid fever. This is usually due to the now forbidden practice of fattening oysters in a place where sewage is discharged into the ocean. If there are pathogenic organisms in the sewage, an epidemic may occur.

Typhoid bacilli cannot live for any length of time in ice, but a few epidemics of typhoid fever have been traced to ice made from contaminated water.

The importance of flies in disease seems to have been exaggerated. If garbage and sewage were taken care of and thus no contaminated food left for the flies, there would be no danger from them. There is no excuse for leaving typhoid-containing substances exposed to flies. It is quite possible for flies to carry typhoid bacilli from the excretions to food, and flies certainly seem to be a definite factor in the spread of typhoid fever.

Another source of typhoid infection of water and particularly of food has been found recently in the typhoid carrier. After a person has had typhoid fever and is perfectly well, about five per cent of the cases continue for many years to carry the germs of the disease in their stools. "Typhoid Mary" is a typical illustration of a typhoid carrier.

"Typhoid Mary" was a cook and a somewhat itinerant one, so that a number of typhoid epidemics were traced to her. Usually the typhoid bacilli got into the food. A great amount of misplaced sympathy has been wasted on her, since it was necessary for her to commit the sanitary crime of introducing (unconsciously, of course) by her filthy habits particles of her feces into the food. That such habits are not uncommon is shown by a considerable number of food epidemics of typhoid traced to carriers who were cooks. All this illustrates the importance of cleanly habits among people who handle food that is not to be heated subsequently to such a degree that the bacteria will be killed.

Any one who handles a typhoid fever patient or any of the excreta of a typhoid fever patient or carrier may carry the bacteria into his mouth in various ways. He may even infect a limited amount of food. The neglect of scrupulous cleanliness of the hands has been the cause of a considerable number of cases of typhoid fever among doctors, nurses, and others who have handled typhoid material.

Typhoid Fever and War. Much of our knowledge of the prevention of typhoid fever has been gained through our tragic experiences with the disease in wars. Typhoid has always played an important part in wars so that it has been said that an army has two enemies: bacilli and bullets. In our Civil War in the Northern Army there were 75,361 cases of typhoid fever with 27,056 deaths among the white troops, and 4,094 cases and 2,280 deaths among the colored troops. In the Franco-Prussian War, among the German troops there were 73,396 cases with 8,789 deaths from typhoid, representing sixty per cent of the total mortality. The incidence to total strength was very high. There was typhoid fever in every corps of the

army at the beginning of the war. Two factors influenced the prevalence of the disease: the troops carried the infection with them, and they were campaigning in a country in which typhoid fever was common. In the Afghan War of 1878–80 the troops brought the disease with them from infected areas in India, and it was carried to localities where it had been unknown previously. In the Boer War there were 57,684 cases of typhoid fever and 8,022 deaths in the British army.

Probably the worst lesson on typhoid fever was received by the United States in the Spanish-American War. The highest incidence of the disease was among the men who never left the United States but who went into encampments. Among 107,973 men there were 20,738 cases of typhoid fever with 1,580 deaths within six months. In the volunteer regiments ninety per cent of the men who had typhoid fever contracted it within eight weeks after going into camp and these epidemics were as marked in the North as in the South.

Thus typhoid fever in war frequently killed far more than the bullets of the enemy. Moreover thousands of soldiers died of the disease before they even saw the enemy. A well-known surgeon relates how he entered the Medical Corps of the Army for the surgical experience. He had visions of a vast number of serious operations, amputations, and the like. On the contrary his experience consisted of the care of several thousand cases of typhoid fever and one trivial case of bullet wound.

In addition to the knowledge gained by these tragic experiences, a second factor in reducing and almost eliminating typhoid fever in war has been the typhoid inoculation. In 1896, almost simultaneously, Pfeiffer and Kolle in Germany and Wright in England published the results of experiences in the prevention of typhoid

fever by vaccination with the bacillus typhosus killed by heat.

One difficulty which the sanitary experts of the armies had to face was that the etiology of typhoid fever differs somewhat in civil and in military life. There are several reasons for this. In the first place in military encampments there is a greater difficulty in disposing of excreta due to overcrowding and the unusual conditions. This leads to infection in such various ways as the contamination of the water supply, or the bacilli may be blown about or carried by flies. The close contact of men crowded together favors direct infection, while clothing, blankets, and tents may be contaminated. Then, too, there are usually inadequate facilities for ordinary cleanliness. The influence of camp life on troops who had a good water supply was shown at Jacksonville, Florida, in the fall of 1898. There were about 30,000 people in the city and few cases of typhoid, while among the troops nearby, with the same water supply, the disease was prevalent.

The Russo-Japanese War was the first in which the lessons of previous wars and the surer knowledge of how typhoid is spread began to bear fruit. Medical men were utilized to prevent disease as well as to treat it, with the result that the mortality from typhoid fever was reduced tremendously below what it had ever been in a previous war.

In the European War typhoid fever, especially on the Western Front, has been rare. This is due to the absolute sanitary control in the camps and to typhoid inoculation. The relative importance of these measures is not entirely clear. It seems probable that sanitary control is by far the more important since it eliminates not only the typhoid micro-organisms, but all other micro-organisms as well. The value of the

typhoid vaccination, more properly inoculation, seems to be in the additional protection against the almost inevitable lapses of sanitary control.

The sanitary practice in war now involves a number of considerations. Great care is taken in the selection of the camp sites. Strict regulations govern the disposal of sewage. Personal cleanliness is insisted upon. The danger from flies, which was shown to be very real in the Boer War, is removed. Garbage is burned and all food is screened so that flies cannot get at the food. The water supply is such an important consideration that it is examined frequently. No water is permitted to be drunk, except under the sanction of the officers. If a man drinks water outside, he must boil or otherwise disinfect it. Mobile laboratories facilitate the diagnosis of all cases of fever, besides testing all who handle food for typhoid carriers.

Typhoid Vaccination or Inoculation. The amount of protection which the typhoid vaccination affords has been worked out in the United States Army. Out of a group of 60,000 men who were vaccinated, there have been only twelve cases and no deaths over a period of three years. This vaccination is probably not entirely effective against a tremendous dose of typhoid bacilli. In a large epidemic, some of the people who have received inoculation will be sick, but only mildly, and a fatal case of typhoid after inoculation is extremely rare. Of course, it is also true, as it is in smallpox vaccination, that some people do not receive protection, because the vaccination or inoculation does not "take." The duration of the protection after typhoid vaccination is not so long as that afforded by an attack of the disease, which is usually for life. It is desirable that the vaccination be repeated after two to three years and a third time after the same interval.

Typhoid vaccine is prepared as follows. The typhoid bacilli are heated to 55–60° C. or 140° F. for half an hour. This temperature is sufficient to kill the organisms, but some of the poisons of the bacilli will be found in the solution. If a certain number of these bacilli are injected beneath the skin of an individual, he will not get typhoid fever, but he will be slightly poisoned by the dead bacilli so that the defensive apparatus of the body will come into action and will produce a large number of substances which will fight off the poisons. This dose of vaccine is repeated two or three times. After these inoculations, the person's blood will give the same Widal reaction as that of a person who has had typhoid fever. The vaccination causes a slight inconvenience in a small percentage of cases, but no serious illness, and the return in the protection against typhoid fever is considerable.

Typhoid fever is a preventable disease depending upon the sanitary coöperation of the individual and the community. The community can guarantee the safe disposal of sewage and an uncontaminated water supply. The individual must cultivate sanitary personal habits, especially in regard to the excreta of himself and others. Every case of typhoid should be examined after recovery for the purpose of discovering typhoid carriers. Those who handle food, which is a good culture medium for bacteria, which is not subsequently heated, should be examined for typhoid carriers. Those who handle food should observe the strictest cleanliness. We cannot assume that cooks who are typhoid carriers are peculiarly uncleanly in their habits. The correct assumption is that it is far easier than was formerly believed to contaminate food. The indication is certainly plain that the establishment of the custom and the facilities for thorough hand washing is necessary. Food and excreta should

not be exposed to flies. By taking all the above-mentioned precautions typhoid fever can be eliminated. Finally, it should be emphasized again that water is the great carrier of typhoid fever and that until all the communities of the United States safeguard their water supplies as do the cities with few cases of typhoid fever, there still will be cases of the disease and typhoid carriers.

Para-Typhoid Fever. There are a number of diseases and an equal number of causative bacteria which are similar to typhoid and its bacterium. These are known as the para-typhoid fevers, although such fevers are rare in comparison with real typhoid fever. Such fevers are apparently slight deviations from typhoid fever and the difference is only slight. Para-typhoid fevers are caused by the same conditions as typhoid. In the European War there has been a considerable amount of para-typhoid. This suggests that even under good sanitary conditions typhoid fever would have existed had it not been for the effective preventive inoculations. The same sanitary precautions are effective against para-typhoid as against typhoid fever.

Asiatic Cholera

In its transmission and its prevention Asiatic cholera corresponds closely to typhoid fever. Like typhoid, cholera is always caused by an ingestion of the infecting micro-organisms in the alimentary tract. There are also carriers of cholera as in typhoid. Cholera also causes a diarrhea, and organisms of the disease are found in enormous numbers in the stool. The disease is caused by a specific bacterium, a spirillum, which was discovered by Koch. Again, as with typhoid, proper sanitation can eliminate cholera.

It is probable that cholera has occurred for many centuries, but it is noteworthy that unlike most epidemics of pronounced characteristics and high mortality, no clear description of its presence was placed on record. Asiatic cholera is not a disease of special moment in this country as it is primarily a disease of the Tropics. Epidemics start along the Ganges River, for cholera is always present in India, and then sweep over Asia and into Europe in recurring cycles. Whenever an epidemic reaches Europe a few sporadic cases usually reach the United States. During the first three centuries after the discovery of India, cholera visited Europe on several occasions but the first real outbreak was in 1564. However, prior to 1817, cholera was confined to certain parts of India and never permanently infected districts far removed from there.

Since 1817, when an epidemic of unusual severity broke out in India, cholera has been constantly present in endemic form in some parts of that country and has been carried thence by pilgrims or travelers or by their possessions. Many parts of the world have suffered from the disease, and seven distinct invasions of Europe have occurred, the latest being from 1891 to 1895. In 1893 Hamburg suffered a severe epidemic of cholera which was due to the pollution of the water supply. No distinct epidemic of cholera has occurred in the United States since 1873.

The native East Indian, a rather filthy person, is apt to drink out of the same water in which he has not only bathed, but also into which the wastes from his body have passed. The stool is rich in bacteria and the water is bound to be polluted. As the prevention of the disease depends practically entirely on the intelligence of the people and the coöperation of the natives in keeping to the standards of sanitation, the disease still continues. In traveling in the cholera countries,

therefore, it is important to exercise eternal vigilance. Cholera has been a great menace to armies, especially to armies working in the Tropics during the summer. Cholera has, apparently, been prevalent on the Eastern Front during the European War, particularly in Turkey and in Asia.

Cholera can be prevented only by community sanitation. Since the immunity conferred by the disease is relatively short, the use of a cholera vaccine confers only a temporary protection. In Japan it has been the experience that in times of epidemic a vaccine was of some prophylactic value. The vaccine may also be of value to armies on the march, but in general the protection afforded by vaccine is slight.

There is no specific cure for cholera. Under proper medical treatment the disease is not anywhere near so fatal as terrible epidemics which have a tremendously high mortality, for only about twenty-five per cent of the cases die. Cholera, like typhoid fever, runs a perfectly definite course and the patient, if he survives, gets entirely well. About six or seven per cent of the recovered cases are cholera carriers. The longest period during which they carry the infecting microorganisms is six months, but only rarely does this period extend over twenty days.

Other Diseases Spread by Ingestion

Dysentery. There are a few other diseases, of rather less importance, which are transmitted in the same way as typhoid fever, para-typhoid, and cholera. One fairly large group is grouped under the term dysentery.

Under the general heading of dysentery we are apt to include all forms of severe diarrhea of any duration, particularly when associated with fever. There are

at least two closely allied bacilli, somewhat similar to the typhoid bacillus, which cause a definite disease which can only be diagnosticated by the blood tests and the finding of the causative organisms in the stools. Every summer sees a few cases of this bacillary dysentery, a disease which tends to be self-limited. It may become epidemic in armies or wherever people are crowded together in unsanitary conditions in Temperate zones as well as in the Tropics. The prevention consists of the same sanitary regulations which are effective against typhoid fever.

In addition, we have a second specific type of dysentery, due to an amœba or an animal form of life. These amœbæ live in water and in vegetables and fruit. Amœbic dysentery is never epidemic, but occurs as a more or less chronic condition with serious sequelæ. Amœbic dysentery is a common disease of the Tropics, and we are now beginning to recognize a considerable number of cases in the Temperate zone. In the early stages, at least, treatment with ipecac, both by rectum and particularly by the preparation of ipecac called emetin subcutaneously, is effective. Amœbic dysentery is an intestinal infection which gains entrance through the mouth and which is prevented in the same way that typhoid and cholera are prevented.

Dysentery is frequently used as a clinical symptom to designate many conditions with severe diarrhea. These conditions may be due to a variety of causes, some of which are bacterial. The so-called infectious diarrhea and the cholera morbus of children are often bacterial infections. The bacteria gain an entrance through the mouth from food, drink, and contaminated hands. Flies may be a factor. The prevention is the same as that of the other diseases transmitted by ingestion.

In the Tropics, particularly, we find a larger number of pathological intestinal conditions. Various micro-organisms, some vegetable, perhaps more animal, are the causative factors, all of which gain entrance with the food and water.

Food and drink may be the carriers of various small animal parasites or of their eggs. We have already discussed the tapeworms and the trichinæ, which occasionally infect meat and fish, and the necessity of thorough cooking to destroy these parasites. But, in addition, other animal parasites or their eggs may accidentally pollute food and drink and give us a wide variety of diseases. Such conditions, however, are not common in the United States. Among such infecting agents are the flukes (the bilharzia hematobia of South Africa, Egypt, and Asia), and the hydatid worms which cause echinococcus disease. While these diseases are almost unknown to us, they emphasize the necessity of avoiding contamination of food and drink. The hookworms (uncinaria) which usually enter the body through the skin, are apparently occasionally ingested.

There are, of course, still other diseases which are transmitted in the same way as typhoid fever, cholera, and dysentery. Tuberculosis is one of these. Scarlet fever, as a rule, is carried by the so-called droplet method, but it may be caused by the contamination of some food supply, especially milk. A striking example of the transmission of disease is the so-called septic sore throat which is transmitted by milk. Septic sore throat, scarlet fever, diphtheria, and tuberculosis, are sometimes transmitted in the food supply, but not often in the water supply, — although they may be. The reason that milk is such a frequent carrier of disease is that it is an excellent culture medium for bacteria and that bacteria multiply rapidly in it. Milk may also carry certain diseases of the animal

which gives the milk. From the cow tubercle bacilli and streptococci may pass into the milk and respectively cause tuberculosis and septic sore throat. Likewise, goats may pass the infecting agents of Malta fever (a fever occurring along the Mediterranean) in the milk. The prevention of disease from such milk is obvious: (1) sound animals, and (2) pasteurization or boiled milk in case of doubt. But these diseases, except Malta fever, are not usually transferred by ingestion and so they will be discussed under their usual method of transmission.

CHAPTER XII

The Air-Borne Diseases

Under air-borne diseases, by a somewhat loose usage, we may include a long list of diseases in which the channels of entrance and exit are the air passages. The medium of transfer is the air, in which the bacteria, usually breathed, coughed, or sneezed out in droplets, pass from person to person. This group of infections includes some of the most important diseases which affect mankind. This group would still be of the utmost importance if it included no diseases in addition to tuberculosis and pneumonia, which have been running a close race to see which could kill the more people in a year. Just at present pneumonia is in the lead, but pneumonia cannot compare with tuberculosis as a cause of poverty and social ills. Smallpox, diphtheria, and the so-called children's diseases — measles, scarlet fever, whooping cough, and chicken-pox — are all transferred by the droplet method. In some of these diseases we do not know the actual germ, but it has been shown that they are carried from person to person in the air.

In this group of diseases the disease itself may or may not be confined to the respiratory tract which merely serves as a channel of exit and entrance. The micro-organisms of such diseases are usually borne in minute particles of moisture. These droplets are given off through the nose and throat, and another person may or may not be infected by them. The

spread of the infection depends upon three things: the number of organisms, the virulence of the organisms, and the resistance of the individual.

In some instances the vitality of the causative micro-organism is so slight outside the human body that the infection must be passed immediately from person to person. This is frequently loosely called contact, since, to be infected, the victim must come within a short distance of the infected person. This is the case in whooping cough. In other instances the micro-organisms are hardy and live for some time outside the body and close association may not be necessary. This seems to be particularly true of the tubercle bacillus. The sputum of a tuberculous individual may, under favorable conditions, contain the living bacilli for days and even weeks.

Coughs and Colds

Coughs and colds are transmitted in this same way, but in regard to the micro-organisms which cause colds there is a complicated bacteriological tangle. Certain epidemics of colds are apparently caused by the pneumococcus; others by the influenza bacillus, and still others by various organisms. The micro-organism of the common cold has not been discovered, although the researches of Foster suggest that he has isolated the specific bacterium. Attempts have been made to use a vaccine against colds, but they have been of little success, for the reason that the immunity conferred by the disease is short and, further, because we do not yet possess sufficient knowledge of the bacteriology of colds. Colds are not always transmitted through the air. Careless people may infect others by contact, such as by using a common drinking cup or common towel, which may thus afford

the infecting droplets an opportunity of entrance into the nose and throat.

Colds and the allied conditions tend to be self-limited. The infection is aggravated and prolonged by abnormal conditions of the nose and throat and by poor physical conditions, and so the remedial measures are directed largely against these two contributing factors. The cure of a cold is primarily brought about by the body itself, for there is no specific cure.

Colds are extremely infectious as is illustrated by the fact that a cold frequently "runs through" an entire family. We have already mentioned the tremendous economic loss and some of the sequelæ of colds. Colds, like all the air-borne diseases, are difficult of prevention in contrast to the relatively easy prevention of the diseases caused by ingestion. This difficulty is well illustrated by the seasonal occurrences of colds. They are largely winter diseases, merely because in winter we have favorable conditions of spread. These conditions are the close proximity of persons, the closed rooms with the inevitable concentration of the infective droplets, and the usual lessened physical efficiency of winter.

The real danger in this so-called droplet method of infection is the actual proximity of the infected person. The prevention of colds and also of the other air-borne diseases is almost entirely an individual problem. It is incumbent on the individual to avoid and correct abnormality and irritation of the upper air passages and to keep his physical condition as nearly perfect as possible. Then, an intelligent appreciation of the method of spread of the air-borne diseases will enable him to avoid wherever possible the close proximity of infected persons and to prevent the concentration of infective droplets in a closed place. Promiscuous coughing, sneezing, and spitting into any but proper

receptacles are obviously dangerous and should be prohibited. The use of common utensils is also dangerous. At best, infection is always easy, but the individual can do much by developing proper habits to prevent these diseases. Since every case of infection is a starting point for other cases, the continuous prevention of a few cases will mean, in the end, a marked reduction or eradication of these diseases.

Influenza

True influenza is a distinct disease and is not an ordinary cold or "grippe." The disease is due to a specific bacillus which can be isolated readily and which, of course, is entirely distinct from the microorganism which causes the cold or "grippe." Influenza makes its appearance periodically and sweeps over the entire world in great pandemics. It usually starts in Russia and works westward through the continent and thence to the United States. The last great epidemic was in 1894. Since that time influenza has been with us constantly. The transfer and prevention are essentially the same as for colds and the latter depends on the general practice of good personal habits.

Diphtheria

The infection of diphtheria is caused by a bacillus, which is known, after its discoverers, as the Klebs-Loeffler bacillus. Diphtheria is also known as membranous croup. As a matter of fact some cases of sore throat are, in reality, unrecognized cases of diphtheria.

The disease has been recognized for many centuries, but it was not until 1821 that the clinical observations of Brentonneau, of Tours, established its separate identity. Diphtheria occurs in nearly all

parts of the world, but it is most prevalent in the Temperate zone. While it occurs in epidemics and in sporadic cases and is endemic in nearly every large city, it is more common in the country districts. Diphtheria occurs most frequently between the ages of two and eight. One attack does not protect and may be followed by several attacks. It is not uncommon for people who take care of diphtheria patients to come down with the disease, but a goodly proportion of people are naturally immune and do not contract it under any conditions of exposure.

The incubation period of diphtheria, that is the time required for the development of the disease after the infection is received, is short, only one to five days. While the infection is largely conveyed by the air, a number of epidemics have been traced to infected food and drink, notably milk. The writer has recently traced an epidemic to infected salad dressing. Under favorable conditions diphtheria bacilli remain alive outside the body for weeks. As in a number of other diseases, there are carriers of diphtheria. Apparently healthy persons without sore throats and others after recovery from diphtheria harbor the micro-organisms in their throats for varying lengths of time. These people often spread the disease.

The diagnosis of diphtheria can usually be made by an examination of the throat and the symptoms. The only positive method, however, is the examination after twenty-four hours of the organisms which have grown on suitable media from the secretions of the nose and throat.

The average mortality from diphtheria has been reduced one-fourth or more since the introduction of antitoxin in 1894. The duration of the individual attack has been shortened and its severity lessened. Moreover, through the use of prophylactic injec-

tions of antitoxin, the spread of the disease has been checked and numerous epidemics brought to an end. In one hospital, February to June, 1894, 448 children were admitted suffering from this disease and 109, or 24.5 per cent, died. Serum was used. In another hospital over a corresponding period of time, out of 520 cases 316 or sixty per cent died. Here no serum was used. With the improvement in antitoxin, an analysis of 80,000 cases that received it at any time showed a mortality of fifteen per cent. If antitoxin is used in the first two days of the disease, the mortality is under eight per cent.

In 1883, the year before the discovery of the diphtheria bacillus, which enabled a positive diagnosis to be made, 97 out of every 100,000 of the population of the eighteen largest cities of Europe and America died of diphtheria. Undoubtedly there were many more deaths due to diphtheria but attributed to other causes since an exact diagnosis could not be made. In twenty years the mortality had been reduced somewhat, due largely to the ability to make an early diagnosis and to quarantine. In 1900 in the United States registration area the mortality from diphtheria was 43 per 100,000. The decline since 1900 is relatively greater than that shown by any other important cause of death. The decline in the mortality is much greater in diphtheria than in any other of the air-borne infections and must be attributed to the increasing use of antitoxin. It must be remembered, furthermore, that even to-day a large proportion of the fatal cases of diphtheria either do not receive antitoxin or only when moribund. The antitoxin reduces the mortality from diphtheria in two ways. Given to the patient it acts as a cure for the disease. Given to exposed persons it protects them from contracting the disease. To be sure the protection afforded is short — only two to

six weeks — but that is sufficient to protect during the course of an ordinary epidemic.

Diphtheria antitoxin is a substance, or substances, in blood serum, usually of a horse, which neutralizes the poison or toxin given off by the bacillus of the disease. In the case of the diphtheria bacillus, the toxin is a poison which is not in the bacteria itself, but which is diffused throughout the system of the individual. Recovery depends on the presence of antitoxin which may be produced naturally by the body or supplied artificially. The blood from a horse, which has had diphtheria toxins injected repeatedly at suitable intervals, neutralizes the poisons of diphtheria in enormous amounts, but not at all the poisons or toxins of other bacteria. The fluid part of the blood of such a horse, after coagulation, which is known as serum, when given to the patient suffering from diphtheria, will neutralize all the poison of diphtheria in the body of the patient. The effect is due to the antitoxin in the serum and not to the serum itself, although serum and antitoxin are sometimes incorrectly assumed to be synonymous. Diphtheria antitoxin was the first and it is still the most effective antitoxin we have. The effects of the diphtheria antitoxin disappear rather rapidly and only protect for a short time. In other words, the antitoxin will not protect for any longer time than an attack of the disease.

It should be rather easy to stamp out diphtheria, because there is available an early method of diagnosis by means of cultures taken from the nose and throat, the cure of the disease itself by antitoxin, and the prevention of transmission of the disease by making all exposed persons immune through the use of antitoxin. Furthermore, it is possible to tell by bacteriological examination at what time the patient ceases to harbor the micro-organisms and by the same simple

method detect carriers. This examination is so important that it is performed free of charge by all state boards of health and by the boards of health of most cities.

There has been perfected recently a test which shows whether a person is certainly immune to diphtheria (Schick's test for antitoxic immunity). This test enables us to determine a percentage of those persons who are actually immune. While the reduction in the diphtheria mortality has been marked, yet it is the failure to utilize these additional weapons which we have in diphtheria as in no other disease, which explains why this disease has not been practically eradicated. Unlike most air-borne infections, early diagnosis by the bacteriological examination is easy and accurate and thus prevention by quarantine and isolation not only of those actually sick but of all carriers is unusually effective. In handling a case of the disease great care should be used in the disposal of material contaminated by the secretions, for, under favorable conditions, the diphtheria bacillus may be long lived outside of the body. Fortunately, the bacillus is easily killed by the ordinary methods of disinfection.

The claim is sometimes made that antitoxin works harm. It is argued that lockjaw and various loathsome diseases are introduced into the body with the antitoxin. Since the horse is not susceptible to and cannot carry most human diseases, including syphilis, the introduction of disease must be due to gross carelessness in the handling of the serum. Obviously every precaution should be taken in securing the serum. All sera are now licensed by the U. S. Public Health Service, and in Massachusetts and other states, the state itself produces the antitoxin and guarantees its purity.

Some eight to ten days after the injection of antitoxin certain patients have rashes and, rarely, joint pains. This condition, called serum sickness, is transitory and is due to the injection of a foreign serum. Thus it is a mild manifestation of anaphylaxis. In very rare cases (less than a hundred have been collected) severe anaphylaxis and death may develop immediately after the injection of the serum. In most cases the individual had previously shown marked susceptibility to horse protein, usually in the form of asthma when near horses. Individuals with a history of horse asthma should receive antitoxin produced in some other animal than the horse.

Children's Diseases

The term "children's diseases" means that such diseases are so contagious that an individual will catch them as soon as he goes out and mingles with his fellow beings. All of the children's diseases are spread by the droplet method of infection. We include in this category, as a rule, measles, scarlet fever, chicken pox, mumps, and whooping cough.

Measles. Measles has been known for so long and through so many generations that the race has acquired a certain immunity to the disease. A moderate protection is conferred by one attack of measles, and second attacks are not common. The incubation period of measles (the time from exposure to the development of the disease) is nine to eleven days.

The exact cause of measles is unknown, but we do know that it is a disease peculiar to man, although it can be given to animals. In common with a number of other diseases, measles starts as an ordinary cold, but the rash, which is the only way in which we can diagnose the disease, may not appear until the person

has been ill for three or four days. Experimentation has shown that the poison has been in the blood and nasal secretions before that time. This is an important point, because it means that people, usually children, wander about thinking that they have an ordinary cold. Then they come down with measles after spreading the disease far and wide. The prevention of measles is difficult for this reason. So far as we know, measles is spread almost entirely by the droplet method from secretions of the nose and throat, just as are colds, but measles are, if anything, the more "catching."

There is no evidence that measles is spread from the skin, and the scaling of measles, often regarded as highly dangerous, probably never carries the disease. Possibly there are carriers of measles or the disease may be transferred by a third person. However, this point is not established by bacteriological examination, since we do not know the organism. All our evidence points to the immediate transfer from person to person, particularly in the pre-eruptive stage before the diagnosis is possible and also by unrecognized cases.

Measles is notoriously communicable, but close proximity to patients or discharges from the nose and throat seems to be the determining factor of infection. For example, measles can be cared for in the same building or in the same ward with other patients and the disease will not spread. But this requires the most scrupulous precautions of asepsis. The disease is not air-borne in the sense that a current of air from the room of the patient with measles carries the infection into another room. The method of infection seems to be the transfer of the moist secretions of nose and throat by the droplets of coughing or sneezing in the air or by contaminated hands and the like. Disinfectants and fumigation after the convalescence of the patient

are of little importance. The strictest precautions should be observed in the possible transfer during the course of the disease. In epidemics rigid quarantine is necessary not only for those with the disease, but also for those exposed until the incubation period of ten days is past.

Measles is usually regarded as an innocuous disease, but measles and its sequelæ, especially pneumonia, cause many deaths. As a rule it leads scarlet fever in the mortality tables, but in 1914 measles was exceeded by whooping cough. German measles is merely a mild disease very similar to measles.

Scarlet Fever. Scarlet fever is one of the most important of the children's diseases from every standpoint. We do not know the exact cause of the disease, although Dr. Mallory, of Boston, has made a preliminary report on a bacillus which may be the infecting agent. Scarlet fever is usually transmitted through the air by the droplet method, but there have been several large epidemics in which the disease was carried by milk. Scarlet fever is not so communicable as measles. It may be carried from one person to another by an indirect method either by persons or by inanimate objects.

Scarlet fever is contracted through the nose and throat. The onset of the disease is usually from two to five days after exposure, and the first symptom is usually a sore throat which antedates the eruption by one or two days. Incurable nephritis (kidney disease) is frequently traced to an earlier attack of scarlet fever. Valvular disease of the heart is another sequela. In some epidemics of scarlet fever the immediate mortality reaches thirty per cent, but this is unusual. The danger in scarlet fever is on account of the remote complications. Measles is the immediate cause of more deaths than scarlet fever, due not

to the measles itself, in which the mortality is low, but to the immediate complications, especially of the lungs. Yet scarlet fever is a more serious disease than measles on account of the frequency and severity of the remote complications like nephritis and heart disease.

One attack of scarlet fever seems to protect against another attack, but cases of individuals having it twice are by no means rare. Since we do not know the organism of the disease, the recognition of the length of infectivity of a patient, of carriers, and of mild cases is impossible. Like measles, the disease is usually only to be diagnosticated by a rash which is by no means the initial symptom. Prevention is extremely difficult. All the evidence points to the transmission from the discharges of the nose and throat and the disease probably gains entrance in the same way. For years the period of scaling, which occurs late in the disease, was regarded as the main infective period and the scales were considered to carry the disease. There are unquestionably scarlet fever patients who spread the disease after recovery, but, almost invariably in these cases, the early inflammatory condition of the nose and throat has not entirely subsided. For the release of patients from quarantine a normal nose and throat seem to be a fairer criterion, both to the patient and the public, than the absence of scaling.

The writer is familiar with a case of scarlet fever in which, before the eruption appeared, a surgeon performed tracheotomy to prevent suffocation. The next day the child showed a typical rash of scarlet fever, and later the surgeon developed the disease. As the surgeon operated with gloves and in a surgical gown, the presumption is that the infection was by droplets from the throat before the eruption occurred. Scaling was much delayed in the case of the surgeon

and it was afterwards learned that he mingled with people to such an extent that if the scales carried the disease widespread infection should have occurred. In point of fact no case developed. Such incidents could be multiplied.

During the course of scarlet fever not only should active and strict quarantine be employed for actual cases but also isolation in an epidemic for all sore throats and exposed persons. As in the case of measles, quarantine need not demand separate buildings as the air itself is not dangerous as it passes over and from the patient. The danger lies in particles of infective material from the nasal secretions, usually carried in small droplets directly to the nose and throat of other people, but these particles can be transferred in many ways during close proximity. The proximity of handling, for example, is dangerous. So all secretions of the nose and throat should be disposed of carefully. So-called terminal disinfection after the disease may be used, but it is of doubtful value.

Chicken Pox. Chicken pox is a mild disease which results from some unknown cause. One attack seems to protect against another attack. The incubation period is probably about twelve days. From the point of view of health chicken pox is not a dangerous disease. The onset is usually as a cold, so the methods of transmission and prevention are presumably the same as those for colds, measles, and scarlet fever. Mild unrecognized cases frequently spread the disease.

Mumps. Mumps is another of the so-called children's diseases. Mumps is characterized by a swelling of the parotid and sometimes of all of the salivary glands. Here again we do not know the cause of the disease, but it is presumed that the infecting agent is a micro-organism. The incubation period is about three weeks. One attack gives only moderate protec-

tion against a subsequent attack. With the exception of the fact that mumps causes no rash, it is similar to measles, scarlet fever, and chicken pox. The methods of transmission and prevention are the same. Here, again, the person may not know that he has the disease and so spread the infection. Any fatality from mumps is an excessively rare occurrence. A not uncommon complication of mumps is the involvement of the testicles in the male and the ovary in the female. If both testicles of the male are involved, sterility may result.

Whooping Cough. Whooping cough belongs in the group of children's diseases. We know that the causative agent is a small bacillus which has been isolated. Whooping cough is an important cause of disease and death among children, and in weak, puny children it is apt to cause serious complications. While the disease in itself may not be especially serious, deaths due to it directly or indirectly are rather common. In 1914 whooping cough was given as the cause of more deaths than measles or scarlet fever. The mortality figures vary widely from year to year and there seems to be no general tendency to increase or decrease. One attack of whooping cough more or less prevents other attacks. Attempts have been made to secure a vaccine or antitoxin, but the difficulty lies in the early recognition of the disease, for it may go on for a week or so before it is recognized. Even after recognition the disease, and sometimes the infectivity, may persist for weeks.

Whooping cough is usually only communicable by immediate association. The infection is presumably carried from the secretions of the nose and throat, but it seems to be short lived outside the body and only transferable for short distances. Some of the domestic animals seem to suffer from whooping cough and

may transfer the disease. The prevention is by quarantine of the victim. Fumigation is unnecessary, but the proper disposal of the discharges from the nose and throat is important.

General Considerations in Diphtheria and the Children's Diseases. All these diseases have certain characteristics in common. All apparently originate in the nose and throat, and most of them start like a cold or sore throat and may be difficult of recognition in the early stages. Ever since we have had statistics of disease, we have had little diminution in the children's diseases, with the exception of diphtheria. And until we know the precise causes of the infections we cannot know the precise methods to combat the diseases. We have frankly to admit that in combating this group of diseases we have not been very successful. Isolation has not been successful. But we can point out that smallpox, the worst of these air-borne diseases, has been prevented by vaccination.

With the exception of diphtheria, the chief dependence for the prevention of the spread of this group of diseases is by quarantine. And yet, due to the difficulties of diagnosis, the cases are often at large when perhaps most dangerous. The general method of boards of health in combating these diseases is to placard the house of the victim, which makes a sort of quarantine or isolation. In measles the attendants are allowed to go about. More precautions are taken with scarlet fever. These methods are, of course, important, particularly where they include the isolation of suspects and exposed persons, but they are probably of greatest moment in the education of the people to a knowledge that these diseases are communicable.

The efficiency of quarantine can be tested by the examination of statistics. While quarantine has

doubtless prevented widespread epidemics, yet, in the main, scarlet fever, whooping cough, measles, mumps, and chicken pox go on in much the same amount now as formerly. But not so with diphtheria. During the same period — since 1880 — the prevalence of diphtheria has been reduced enormously, but in this case we have the use of other means than quarantine. In addition we may recall the ineffective control of smallpox in Germany by the most rigid quarantine. Quarantine should not be given up, but it seems certain that such diseases as are spread from the secretions of the nose and throat and are presumably carried in the form of droplets, either in the air or in discharges, more or less directly to other people, can be eliminated by quarantine very slowly if at all.

Then, too, we are inclined to speak of quarantine as a fixed thing. Chapin, of Providence, has done much to upset our complacency about quarantine. What is effective quarantine for one disease on account of definite characteristics of the disease and the micro-organism, may not be at all effective for another. In the past we have taken elaborate precautions about the transfer of air, but our efforts were probably wasted. Smaller and larger particles of the secretions of the nose and throat are the dangerous agents. These particles as "droplets" are propelled directly by coughing into the noses and throats of other people. In addition, these particles, especially with children, can be transferred on common utensils, common toys, and the like. Nasal discharges and sputa carry the infection and preserve the life of the infecting bacteria. But these infections are probably not air-borne in the sense that ordinary air conveys the infection to direct points. They are air-borne only as the droplets stay in the air. The term "contact", meaning proximity, is being applied more and more to this type of case.

The quarantine, as Chapin has shown, should be directed towards the possible transfer of the nasal or buccal secretions. This includes droplets in the air, all utensils, and the like. Further, it puts precautions on the attendants. Under such conditions patients will not infect others in the same room. But, on account of human frailty, it is desirable to leave a wider gap than this between infected patients and others, and thus the desirability of continuing quarantine. Until we have additional methods of prevention, like vaccination against smallpox, the early diagnosis, and the curative and prophylactic antitoxic serum in diphtheria, we must not expect too much of quarantine.

In addition to quarantine, much or more can be accomplished in the way of prevention by sound habits of hygiene on the part of the individual. Everyone should be extremely careful of all infections of the nose and throat. Any cold is a possible beginning of any one of these special infections, and this is another point in favor of a reasonable quarantine of the ordinary cold. In general, the prevention of colds and the prevention of these air-borne and contagious diseases depends upon the same factor, — that of personal hygiene. Quarantine will always be necessary as a public measure, but personal hygiene is of greater importance and should be so regarded.

Fumigation may or may not be of value. It often gives a false sense of security, for the so-called terminal fumigation is usually carried out when, by the nature of things, all the infecting micro-organisms have died out. Fumigation may be perfectly scientific, but, when we do not know the cause of a disease, our fumigation is entirely experimental since there are no means of checking it up. Again the value lies in the education of the people by giving them a concrete example of the fact that the disease is communicable.

The simplest and probably the most effective method of fumigation is to open the windows and let in the sunlight and fresh air and not allow the room to be occupied for a few days. Thorough mechanical cleaning with soap and water is probably of value.

Pneumonia

Next to tuberculosis in importance is pneumonia. This disease causes ten per cent of the deaths in the United States each year. Formerly tuberculosis caused more deaths than any other disease, but now pneumonia ranks with the "Great White Plague." The death rate from pneumonia fluctuates widely from year to year and one is inclined to suspect the accuracy of some of the records of deaths. In 1900, the death rate from pneumonia was 180.5 per 100,000, and in 1914, 127 per 100,000. The figures for 1914 were the lowest on record, but with the general reduction of deaths pneumonia now causes a greater proportion of the mortality than formerly.

Pneumonia may be defined as an inflammation of the lungs and the usual cause of the disease is a bacterium belonging to the coccus group, the pneumococcus. The disease attacks people of all ages, in all climates, of both sexes, at all times of the year. Old people are particularly apt to be carried off by it, as are people in poor condition, especially the chronic alcoholics. Pneumonia occurs in early life and is moderately fatal, but in old age it is so fatal that it is called "the friend of the aged." In middle life the mortality varies. Roughly the mortality from pneumonia runs about twenty per cent.

Pneumonia is another of the self-limited diseases. Recovery from pneumonia is extremely rapid. When the disease has run a typical course, the fever often

drops suddenly to normal, a so-called crisis. The immunity afforded by an attack of the disease lasts only a short time, and people who have had it once are rather more liable to have it again. It is evident, therefore, that if the disease does not protect against another attack, certainly no vaccine will.

Pneumonia was formerly considered one of those diseases which "happen", and there was considerable difficulty in recognizing that it was communicable. The discovery of the pneumococcus as the cause of the disease did not solve the problem. Pneumococci are found in many normal mouths and the same organisms are, furthermore, the cause of colds, tonsillitis, and other more or less mild disturbances. While there are on record a number of definite epidemics of pneumonia, it is rare for doctors and nurses to contract the disease in their care of patients. Then, in all general hospitals patients suffering with pneumonia are, as a rule, cared for in the open wards and cases among the other sick do not develop. It has been suggested that, since the pneumococcus is a rather easily destroyed organism, ordinary proximity is not dangerous. Another suggestion is that the factor of resistance may be the determining factor. Yet these suggestions do not explain adequately the enormous number of cases of pneumonia. As a matter of fact we have no complete solution, but recent researches, especially at the Rockefeller Hospital in New York, have given us much additional knowledge.

We now know that pneumococci may look alike and grow in the same way, but still be different. There are at least four groups of pneumococci. The pneumococcus present in the normal mouth is not found in the form of pneumonia with a high mortality. Still, not only the patient, but those who care for the patient, may harbor in their mouths for a few weeks not the

ordinary mouth pneumococci, but the pneumococci of that particular pneumonia. These facts were brought out in the attempts to secure an antitoxic serum for pneumonia. It was found that the serum of a horse, highly immunized by a particular pneumococcus, contained abundant antitoxin, but that this antitoxin was only effective against the toxin of that one type of pneumococcus. The story of these attempts to find a serum and to identify the various types of pneumococci is complicated and is only just begun. It is sufficient to say that, in spite of tremendous obstacles, sera have been developed, which are promising of future achievements, but as yet no such brilliant results as are seen in diphtheria antitoxin have been attained.

In the meantime, while the mechanism of infection in pneumonia is not entirely clear, pneumonia should be seriously regarded as a communicable disease. Considerable quarantine should be enforced and strict precautions should be taken to disinfect all the excretions of the patient, particularly the sputum. We still lack the necessary knowledge to expect successfully to combat the disease or to prevent it to any marked degree.

Tuberculosis

Tuberculosis is an infectious disease which is caused by the tubercle bacillus. The disease may infect any tissue of the body and may assume a wide variety of manifestations, but the most common form of tuberculosis is that of the lungs — consumption or phthisis. Five-sixths of all the cases of tuberculosis and of the resulting mortality are due to consumption. But it must be remembered that it is the same bacillus which causes all forms of tuberculosis and that the non-pulmonary forms of the disease may be fatal and a focus of infection.

Tuberculosis of the lungs or consumption was well known to the ancient physicians. Babylonian tablets contain accounts of the disease, and Hippocrates (B.C. 460–376) gave a lucid description of it. The latter taught that "the consumption came from the consumptive", that "if the patient is treated from the beginning, he gets well", that change of residence is beneficial, and that "the most dangerous disease and the one which proves fatal to the greatest number is consumption." But the teachings of Hippocrates were disregarded until the middle of the nineteenth century. In general, consumption was regarded as a manifestation of Divine displeasure. It was usually considered to be hereditary and the best medical authorities taught that the disease was not catching. Consumption seemed to be incurable. The sporadic attempts of a few medical men to furnish their consumptive patients with fresh air were ridiculed and the patient was confined to a heated, closed room in which remarkable precautions were taken to keep out sunlight and fresh air.

Knowledge concerning tuberculosis accumulated slowly. Bayle (1803) and Laënnec (1819) recognized the unity of all the various manifestations of tuberculosis. In 1865, through experimentation, the disease was transferred to animals. In 1882 appeared the epoch-making work of Koch announcing the discovery of the tubercle bacillus and describing its habits. Since that time we have been able intelligently to study tuberculosis in view of our knowledge of the cause. But increased knowledge has also brought an appreciation of the difficulties connected with the problem of tuberculosis.

Frequency of Tuberculosis. Autopsy examinations have shown that from forty to ninety-five per cent of persons dying from any cause have in their bodies

some focus, usually healed, of tuberculosis. Furthermore, the incidence of tuberculosis at autopsy is nearly as frequent at fifteen years as in adult life. In this connection it is necessary to draw the important distinction between infection with tuberculosis and the disease of tuberculosis. The scar indicates that the person has, at some time, been infected with the tubercle bacillus, but the existence of the scar does not mean that the person was ever sick with the disease or that he was a source of infection to others.

But these facts and those of the known incidence of the disease permit the following deductions: (1) Most individuals have been infected with tuberculosis. (2) This infection usually occurs in childhood. (3) The infection is not usually followed by manifest tuberculous disease. (4) Manifest tuberculosis or tuberculous disease may develop many years after the infection. Thus we can explain the incidence of a case of tuberculosis apparently remote from a focus of infection. Of still greater importance is the application of all known measures to prevent not only infection, but the change from infection to disease.

Mortality and Morbidity Statistics. Up to about 1880 tuberculosis caused from one-fourth to one-fifth of all deaths. With the discovery of the tubercle bacillus and with the application of the knowledge that the disease is communicable, the mortality from tuberculosis has slowly decreased. This decrease has only been noted, however, in those communities in which precautions have been taken to prevent the spread of the contagion. The reasonable isolation of the consumptive has everywhere been associated with a reduced mortality. Thus statistics of tuberculosis mortality vary widely for different localities. In the United States in 1915 tuberculosis caused slightly more than ten per cent of all the deaths, a total of

98,194 in the registration area which covers two-thirds of the population. Presumably 150,000 die annually of tuberculosis in the United States. As a basis for comparison, it may be remarked that in the Civil War there were killed or died from wounds 205,000, averaging about 50,000 each year. The reduction from twenty to twenty-five per cent of all deaths as before 1880 to ten per cent in 1915 is to be attributed to the various preventive and curative measures directly depending on Koch's discovery of the causative agent.

There are no means of determining how many people actually suffer from tuberculosis. From various studies it seems probable that for each death there are at least ten sufferers from the disease in any given year. Hence there are probably at least 1,500,000 sufferers from tuberculosis in the United States at the present moment, or one out of every seventy persons. Out of every ten births, one out of ten will die of tuberculosis sooner or later.

Age Incidence. The average age at death from tuberculosis is between thirty and thirty-five. Every third death during the working period of life is caused by tuberculosis. The average period of total disability before death is over one year, and this is preceded by a period of partial disability likewise averaging over a year. Thus tuberculosis not only causes death during the most active period of life, but the long disability before death is frequently a greater financial burden and loss than the actual death. Even recovery from tuberculosis entails a large financial burden.

Cost of Tuberculosis. Statisticians have attempted to determine the monetary loss caused by tuberculosis. But it is obviously impossible to translate into figures the human suffering, the misery of poverty, and many other ills which tuberculosis causes. If we accept $8,000 as the value of the adult life, including the

average earning capacity for the future, we find a yearly loss of $1,200,000,000 in the United States alone. Such computations do not include the recovered cases and are of interest only as indicating in a small measure the tremendous wastage of tuberculosis even when translated into dollars and cents.

Transmission of Tuberculosis. Tuberculosis is not hereditary. A few cases have been recorded where the mother transmitted tuberculosis to the child in the uterus, but this is excessively rare. Formerly we heard much of an inherited predisposition to tuberculosis, but it is easily possible to explain the well-known frequency of the occurrence of tuberculosis in families on the basis of increased exposure. It may be stated definitely that there is no positive evidence of an inherited predisposition to tuberculosis.

The tubercle bacillus may gain entrance into the body in the following ways:

1. Through the air passages by means of droplets directly from a coughing consumptive, or indirectly from air-borne particles of sputum or the use of common utensils.

2. Ingestion, especially in milk from tuberculous cows, or food which has been contaminated with tuberculous material in handling or by flies.

3. Through the skin. This method is rare and usually gives rise to a local tuberculosis of the skin.

By far the most common method of transmission is the first. The tubercle bacillus is rather hardy outside the human body, and such bacilli have been found alive in dried sputum after six months. They may live in water for several months. Living virulent tubercle bacilli apparently live almost indefinitely in butter. Moisture and darkness favor the prolongation of the life of the tubercle bacillus, while drying to desiccation of the contaminated material and sunlight favor its

destruction. This bacillus is killed by ordinary disinfectants, but penetration of the material, as sputum, is necessary.

Any material which contains tubercle bacilli may spread the disease. It may be spread by all the discharges of a tuberculous patient and by the discharges and the use as food of tuberculous animals. But the general sources of infection are two: the consumptive and his sputum, and the tuberculous cow and her milk. The sputum of the consumptive is generally agreed to be the most important factor in the spread of the tubercle bacillus.

Prevention of Tuberculosis. The first consideration in the prevention of tuberculosis is the prevention of infection. It is obviously desirable that all material containing tubercle bacilli be destroyed before it can infect others, but this is only theoretically possible. Presumably there are a million and a half persons with active tuberculosis in the United States, and institutional segregation of such a multitude is not feasible. Furthermore, many consumptives go for months or years spreading the disease in complete ignorance of the fact that they have tuberculosis or that they are a possible menace to all with whom they come in contact. Long experience, especially in tuberculosis hospitals, shows that the diagnosed consumptive who is intelligent and obedient can be cared for under suitable conditions without menacing the health of others. Under such conditions it is possible to control tuberculosis not only in hospitals but in the home. But in general we are far from meeting the requirements. Frequently tuberculosis is not diagnosed, and this fault may be divided between the medical profession and the laity. The consumptive may not seek a physician or he may refuse a thorough examination. The physician may be at fault in not performing a

thorough examination as well as in failing to detect the disease. In this connection there are several rather complicated considerations. The diagnosis of tuberculosis may be difficult and demand training and equipment not possessed by many physicians. The board of health laboratories which examine sputum for tubercle bacilli free of charge help to ameliorate this difficulty, but these laboratories are used far too little and too often a single negative sputum examination is accepted as final.

Again the patient may be unable or unwilling to pay for a thorough examination, particularly when he feels convinced that the alleviation by drugs of a troublesome cough will make him well. The physician, perhaps, cannot afford for a small fee to spend the time on the thorough examination of all his patients, particularly when he knows that most of his patients will prove to be sound. The increased number of tuberculosis dispensaries and the various schemes for encouraging the periodic complete physical examinations in health have not solved this aspect of the problem. Such schemes reach only special classes and not the average man or woman.

A further complication is seen in the reluctance on the part of the physician and the patient's family to acquaint the patient with the disagreeable truth. In ignorance the patient does not benefit either himself or the community by the mere fact that the diagnosis has been made. The solution of the difficulty attending the early diagnosis of tuberculosis lies exclusively in the education of both the medical profession and the laity. To the individual early diagnosis means the only possibility of cure; to the community early diagnosis means the prevention of the spread of the disease.

Only the patient who understands the possibilities of the transmission of tuberculosis can be trusted to

take care of sputum and other discharges which contain tubercle bacilli. Since many other diseases are spread in the same way as tuberculosis, it is imperative that as far as possible all persons, whether manifestly diseased or not, should exercise reasonable precautions. Habits firmly fixed in health can be trusted in disease. Hence education concerning coughing, promiscuous spitting, and the use of common utensils should be universal and not restricted to the known consumptives or other disease carriers. Many persons are unrecognized disease carriers and every individual is a possible disease carrier in the future. The community has an obvious duty in regard to the ignorant, refractory, or incorrigible consumptive, — the compulsory segregation of such persons under such conditions that they cannot menace their fellow beings.

In many instances the conditions of the consumptive are such that adequate precautions are impossible. The consumptive himself may be willing, but too sick. The conditions of work or living may be such that infection of others is a certainty. Here we find the pressing problem of the home-care of the consumptive in all conditions of society except the well-to-do. A family of seven in a three-room tenement furnishes conditions which preclude the exercise of satisfactory precautions. The presence of young children with the careless habits of childhood furnishes an important factor of difficulty. We have already noted the frequency of tuberculous infection in childhood, which may be largely attributed to the impossibility of eliminating the unhygienic habits of children. Tuberculosis cannot be controlled in the conditions of poverty, overcrowding, and ignorance. Ample statistics are available, which show that the institutional segregation of the advanced consumptive is followed in all countries by a fall in the death rate. The advanced

consumptive daily expectorates millions of tubercle bacilli, and he can be controlled and the spread of the disease prevented only under the conditions which have been described. An important part of the tuberculosis prevention work consists in the increased accommodations for the advanced consumptive in hospitals where adequate precautions against the spread of the disease are possible.

Man is by no means the only carrier and source of tubercle bacilli and tuberculosis. The disease occurs in cattle and other mammals, in birds, and in some of the cold-blooded beasts. It is only in cattle, however, that tuberculosis of other animals is of real importance to man. Bovine tuberculosis is caused by a tubercle bacillus which is typically somewhat different from the human tubercle bacillus. The bovine tubercle bacillus in its typical form probably does not cause consumption, but it is a frequent cause of tuberculosis of the intestines and the peritoneum, of glands (scrofula), of tuberculosis of the spine (Pott's disease and humpback), of tuberculosis of the joints (hip disease, white swelling), and of fatal generalized tuberculosis with tuberculous meningitis. Over one per cent of beef cattle, over two per cent of hogs, and five to twenty-five per cent of dairy cattle show tuberculosis. The disease rarely affects the muscles of animals, and, in any event, thorough cooking will destroy the bacilli and render the carcass entirely safe for human consumption. The main source from which bovine tubercle bacilli enter the human body is milk, and in order that such bacilli be present in milk, it is usually necessary that the cow have tuberculosis of the udder. Collected statistics from all parts of the world show the frequency of tubercle bacilli in milk, the percentage varying from five to twenty per cent. Butter is slightly more frequently infected with tubercle bacilli.

The bovine infections in man are essentially alimentary in origin and are largely restricted to childhood when the diet is to so large an extent made up of milk. This explains the frequency of scrofula (tuberculosis of the glands of the neck) and bone and joint tuberculosis in children. Such tuberculosis is not necessarily bovine in origin, but it probably is in from twenty-five to fifty per cent of the cases. About five per cent of all cases of tuberculosis come from tuberculous cows, but on account of its usual localization only one to two per cent of the mortality is due to bovine tuberculosis. However, this is a form of the disease which can readily be prevented. The tuberculin test, while not infallible, is a reasonably accurate and very useful method of determining the existence of tuberculosis in cattle. Under proper restrictions such cattle may be used for food, but the milk should not be used unless pasteurized. If cows are not tuberculin tested, it is probable that about ten per cent will have tubercle bacilli in the milk. Periodic, careful, and thorough inspection of dairies and cows by trained veterinarians and the removal of all cows with clinical tuberculosis and with any suspicious abnormalities of the udder will eliminate all danger of tuberculosis from milk. Such a procedure is naturally violently opposed by many milk producers, but progress is being made. It is necessary to convince the farmer that milk which pleases the palate may, nevertheless, cause disease. But the facts are incontrovertible and despite the hardships of strict regulations, which are often not uniform in different communities, it is intolerable that we continue to drink tubercle bacilli with our milk and eat them with our butter, when the means of eliminating this source of infection is readily at hand. This source of danger has been underestimated for too long a time, and it can be overlooked no longer.

The second important consideration in the prevention of tuberculosis is the prevention of the development of tuberculous disease from tuberculous infection. While over half of the population is infected with tuberculosis, only one-tenth die from it. The large majority of those infected never develop tuberculous disease. Even our most modern and searching methods of examination, including the X-ray and the tuberculin test, are quite inadequate to reveal to us, as a general rule, the person who is infected with tuberculosis but who has not the disease. We do not know positively the factors which determine the latency or the activity of the infection. We know, of course, that the three fundamental principles which govern all infections also apply to tuberculosis, namely, the amount of the infection, the virulence of the organism, and the resistance of the individual. But long experience with this dread disease has given us valuable additional data. We know how frequently tuberculosis is the cause of death of drunkards, of prostitutes, and of prize-fighters who no longer train but indulge in various excesses. We know that while tuberculosis does not spare the rich, it is more common among the poor. Recent statistics show that the percentage of tuberculosis is over ten times more frequent among the heads of families who earn less than $500 a year than among those who earn $700 or over a year. In other words, poor habits of hygiene and unhealthy conditions of life, whether created voluntarily or by force of circumstances or by ignorance, carry a strong probability that a quiescent tuberculous infection may develop into tuberculous disease.

Tuberculosis is frequently the penalty of dissipation. The tubercle bacillus is practically ever-present, so that the lowering of bodily resistance tends to favor the development of the disease. Hence tuber-

culosis may be rightly called more a social than a medical problem. To eliminate tuberculosis means to eliminate poverty, overcrowding, undernutrition, overfatigue, and lack of recreation. All this, of course, involves a complete readjustment of our social and industrial world. In any event the problem of tuberculosis cannot be separated from the poverty which causes tuberculosis and the poverty created by it. Better housing, adequate food, better hours for labor under better conditions, more parks, and open air schools are steps in the right direction. But it is even more essential to provide adequate machinery by which whatever knowledge and whatever facilities for the preservation of health that we now have may be better utilized.

The Treatment and Cure of Tuberculosis. It must be repeated that most of us have been infected with tuberculosis at some time or other, although we overcome the infection and keep it under control. We know that poor health habits and faulty conditions of life encourage the development of the disease. Sound health habits and faultless conditions of life restrict the development of the disease and create a cure. Even so long ago as Hippocrates it was recognized that consumption was curable if taken in time. Bodington, in 1840, was the first in modern times to possess sufficient courage to oppose the teachings of the day and treat consumption with fresh air and sunlight. In 1854, Brehmer, himself a cured consumptive, built a sanatorium for consumptives in the Black Forest of Germany. In 1883 Dr. Trudeau, of New York, who had found health in the open air of the Adirondacks, established a sanatorium at Saranac Lake. By this time, through the work of Koch, tuberculosis was being understood and consumptives were being cured. Sanatoria were established all over the world. But

even now there is much misunderstanding concerning the functions of sanatoria. Such institutions do not cure in the ordinary sense; sanatorium life provides the essential requirements which make a cure possible. These requirements, in simplest terms, are the best possible health habits and surroundings under competent supervision. The aim is to put the body in the highest state of efficiency and thus combat disease. This procedure is not solely applicable to tuberculosis, but it is also applicable to any other abnormal condition, whether due to infection or other causes, such as excessive fatigue, neurasthenia, and the like. Fresh air and sunlight, rest, which means the conservation of energy and the avoidance of fatigue, and good food in abundance are only the means to the end of physical efficiency. It is possible to secure these requirements at home, but it is usually easier to carry out these instructions in a sanatorium under constant supervision in company with others, away from the usual distractions of the home life. Milk and eggs, so often glorified in the treatment of consumption, merely mean so many easily assimilated calories. The benefits of a change of climate often mean increased opportunity for the out-of-door life and, sometimes, freedom from family cares.

Statistics show that there is no great difference in the percentage of recoveries in sanatoria whether at sea level or in high altitudes. The evidence indicates a slight difference, not yet explainable, in favor of the higher altitudes. Yet the indigent consumptive, who can get rest, fresh air, and good food at home at sea level, will do far better than to endure loneliness on insufficient food in poor quarters at a high altitude.

Eighty per cent of the consumptives in the early stages, under proper treatment, will recover, but this treatment may require months and the exercise of

much fortitude and patience. Furthermore, after the disease is arrested, much care is frequently necessary to prevent the re-development of the disease. The arrested case is like the infected case without the disease, only much more liable to redevelop the disease. Bitter experience has taught us to be chary in the use of the word "cure" in connection with tuberculosis. It is difficult or impossible to be positive that the infection has been permanently destroyed. The cure of a consumptive means more than the saving of an individual life; it means the prevention of a focus which may spread the infection.

In order that a consumptive may have four chances out of five to recover, his disease must be discovered in the early stages. Therefore, the public at large, all liable to this disease, must understand the necessity of seeking medical advice concerning a persistent cough, chest pains, fevers, unexplained loss of weight, and other possible symptoms of tuberculosis. In addition the medical profession must possess the training and equipment for early diagnosis. Only by systematic and widespread education can this be brought about.

Since consumption is such a universal disease, it inevitably follows that cures of all sorts are everywhere recommended. Many things may contribute to recovery. Tuberculin in skilled hands, in selected cases, lung compression under the same conditions, the wise use of drugs, may all be of value. But none of these means is essential. There is no specific cure. There are those who chase such cures. Those that move from climate to climate, from sanatorium to sanatorium, from doctor to doctor make up a small army and they are well described as "tuberculous tramps." Instead of finding the sure and quick cure, they have lost the opportunity which too often comes but once and is soon gone.

Tuberculosis and Housing. Prolonged proximity with consumptives is obviously of great danger, and such proximity usually obtains in houses. Of course, as a rule, the factor which compels crowding is poverty. Investigation in all large cities shows tenement blocks in which there is an average of over two persons per room. Under such circumstances, granted a consumptive, the spread of the disease is almost inevitable. Berlin statistics in 1907 showed that in only sixteen per cent of over 6,000 persons dying of tuberculosis did the family occupy a home of three rooms or more.

In Edinburgh Philip found that in sixty-six per cent of the cases, the affected persons slept in the same room with one or more members of the family, and in eleven per cent more than one more occupied the same room. Such conditions also explain the fact that the infection in tuberculosis is, as a rule, received in childhood.

Miss La Motte, in Baltimore, found that seventy-three per cent of a group of consumptive children came from homes in which there was already tuberculosis. Mac Corrison and Burns, in Massachusetts, found 134 instances of family clusters of three or more in a study of 1,300 cases. Three houses in New York have records of 37, 25, and 19 cases respectively within nine years. Another example of this condition is that of a well-known man who moved away from home early in life. His parents, and all his brothers and sisters remained in the little old homestead and one by one died of consumption. The homestead at last reverted to the only member of the family who moved away and who alone escaped tuberculosis. He had the house burned. In such a house consumption was mainly spread by the constant presence of a consumptive, but the rather hardy tubercle bacilli might well infest every dark nook and corner, and, due to the long-continued extensive infection of every article in the house,

the certain destruction of all the infecting organisms would be difficult. Probably ninety per cent of tuberculous infection of human origin takes place in the living rooms of the house. The incapacitated consumptive often remains at home. He may do light work at home or to him may fall the task of caring for the children. It is certain that in the past we have not appreciated the importance of home infection and the danger to children. Under proper conditions adequate precautions can be taken at home, but the control of the consumptive at home is made more difficult by the presence of children.

Tuberculosis and Occupation. Volumes could be written on the relation of tuberculosis and poverty. For poverty furnishes all the surroundings favorable not only to infection with tuberculosis but also for its development after the individual is infected. It is difficult to disassociate many occupations from the accompanying poverty so common in them. Statistics show that certain trades have a high mortality from tuberculosis. The so-called dusty trades, including the out-of-door quarryman, show mortality from tuberculosis that is far above the average from all occupations. The factor here seems to be the irritation of the lungs which favors not only infection but also development. Out-of-door occupations in general show a relatively low tuberculosis mortality.

As might be expected tuberculosis is rife among the poorly paid indoor trades. On the other hand, one may be surprised to learn that tuberculosis is the cause of more than half the deaths among stenographers and school teachers. The high incidence of tuberculosis here cannot be attributed to any peculiarity of the work, but to the general habits of living. It is not only the indoor work but the general faulty hygiene of life and surroundings which determine this high

mortality. A dusty occupation undoubtedly favors tuberculous infection and the development of consumption. In all other occupations the ordinary factors of health and hygiene, that is, overcrowding, fatigue, bad air, and the like, merely play their proportionate part in the daily total of the individual's health habits and conditions of life.

Conclusions. It is becoming increasingly evident that the problem of tuberculosis in its entirety is too great for private enterprise. The problem is medical, social, and economic. Even in the aspects which are mainly medical, uniform public action and new legislation are necessary. Only by the concerted thorough covering of the entire field of human activity can tuberculosis be controlled. No tuberculosis program is adequate which does not include the following items.

1. Sanatorium provision for the treatment and cure of early cases. Sanatoria are entirely inadequate in this country. Germany has solved, to some extent at least, the financial problem of the erection and maintenance of sanatoria by obligatory health insurance. This problem of health insurance is slowly coming to the fore in the United States, but the decision, unfortunately, lies in the field of politics.

2. Hospital accommodation for the advanced consumptive. This is largely for the protection of the community, but, happily, some advanced consumptives will always recover.

3. Facilities for the early diagnosis of tuberculosis. This will include tuberculosis dispensaries and all methods of the periodic routine physical examination of all persons, in order to detect all cases of tuberculosis. Readily available laboratories are also important.

4. The collection and use of vital statistics. This includes not only the reporting of all cases of illness

and death from tuberculosis, but the investigation of these cases. For example, in Berlin the systematic examination of the 4,500 new cases of consumption revealed 4,500 unrecognized cases of tuberculosis, most of which were in an early and favorable stage for treatment. Furthermore, the source of the infection must be discovered and stopped forever, if possible.

5. Care of the health of children. The infection usually takes place in childhood.

6. Improvement in the general hygienic habits and the sanitary conditions, especially in the homes.

7. The education of the public and of the medical profession. Regulations and legislation will be useless unless there is an intelligent application of the known facts.

Only a few visionaries foresee, in any immediate future, the stamping out of tuberculosis. The infections which are transmitted by droplets and in the air are difficult of eradication, as we know from experience with measles and scarlet fever. The difficulty of making an early diagnosis often presents an obstacle. Furthermore, the incidence of tuberculosis is closely interwoven with our present social and economic status. Nevertheless, despite these difficulties, it is possible to accomplish much in the prevention of this disease, the greatest scourge of civilization, and in this belief we get encouragement from the considerable diminution of the disease already achieved by the application of the discoveries of science.

Cerebro-Spinal Meningitis

Epidemic cerebro-spinal meningitis is caused by a bacterium of the coccus group — the meningococcus. There are still other forms of meningitis which are due to other organisms, and the diagnosis is only made

with certainty by the examination of the spinal fluid after " lumbar puncture."

Cerebro-spinal meningitis has been known in epidemics for centuries. The disease is an inflammation of the lining membranes of the brain and spinal cord, a condition which not so long ago was extremely fatal. The mortality, while varying in different epidemics, was always from sixty to eighty per cent. Now we have a most effective antitoxic serum which is produced by the immunization of a horse. This serum is of little value when injected subcutaneously, so that to be effective it must be applied directly to the inflamed meninges, *i.e.* by injection into the spinal canal. Through the use of the anti-meningococcus serum the mortality of the disease has been reduced to under twenty per cent and there are fewer complications than before the serum was discovered.

The exact method of spread of cerebro-spinal meningitis is not known, although we have learned the following facts. The meningococcus has slight vitality outside of the body, and the disease is most prevalent at the time that the other air-borne diseases are prevalent. While the disease seems to be largely localized in the lining of the brain and spinal cord, virulent meningococci are found in the mucous membranes of the nose and throat and in their secretions, not only in the human but in the experimental disease. Furthermore, a proportion of persons harbor these organisms without ever having the disease. It seems probable, therefore, that the transfer is effected by the droplet method of infection, presumably through the sick and through carriers. Isolation and quarantine of such persons is, of course, necessary, and thorough disinfection of the nasal secretions of the sick should be carried out. Since exposure is only very irregularly followed by the disease and since the administration

of anti-meningococcus serum must be by lumbar puncture, the serum is rarely used as a preventive measure.

Smallpox

Smallpox is a highly infectious disease in which the mortality varies from one to fifty per cent, but the average in the unvaccinated is about thirty per cent. The cause is undoubtedly some sort of a micro-organism, which still remains undiscovered. The infection is probably carried largely in droplets from the nose and throat of the sick to other persons. Infection through the skin is possible. Smallpox is a self-limited disease and there is no specific cure.

History of Smallpox. Smallpox seems to have been known in India and China from time immemorial. Ebers believes that he has found, in the papyrus which bears his name, a reference to the existence of smallpox in ancient Egypt (about 3700 B.C.). Throughout classical and medieval times references to the occurrence of smallpox are comparatively numerous. In the sixth century of the Christian Era, Bishop Marius, of Lusanne, and Gregory, of Tours, wrote of epidemics of smallpox sweeping over Italy and France, thus giving the first positive references to the disease. The oldest known medical account of this scourge seems to be that of the Arabian writer Rhazes in the tenth century. In more modern times there are records of epidemics of smallpox in almost all parts of the civilized world. The disease is said to have been introduced into America (1520) by a negro who accompanied Cortez on his expedition into Mexico. It appeared among the New England Indians in 1633 and since that time America has never been free from smallpox. It is estimated that from 1700 to 1800 an average of 760,000 persons died from smallpox each year

throughout Europe. It was a proverbial saying "that few escaped smallpox and love."

No historical fact is better established than that before the discovery of vaccination smallpox was one of the most fatal and dreaded scourges of mankind. So widespread was the disease that, as Macaulay informs us, it was a rare thing at one time to find a person in London not disfigured by smallpox. To have had smallpox was a valuable recommendation in seeking employment. An advertisement of the eighteenth century reads: "A parcel of likely negro women and girls, 13 to 21 years of age, who have all had smallpox, were lately imported." The experience of the city of Boston is illuminating of the conditions. The population at the time of the epidemic was 15,684. Of these 5,998 had had the disease. During the epidemic 5,545 contracted the disease, while 2,124 were inoculated with it; 1,843 left town, so that there were in the city only 174 persons who had never had smallpox.

Before the introduction of vaccination smallpox was more common than measles, and, on account of its infectivity, people usually contracted it in childhood. One-tenth of all deaths were due to smallpox, and in years of epidemics it was the cause of half the deaths. More than half of the living carried the scars of smallpox and blindness was a frequent result.

Now, little more than a hundred years later, comparatively few people in this country ever see smallpox and the story of this scourge has come to be almost legendary. In our present-day security many people have come to doubt the dangers from this disease and even maintain that it is extinct. Yet in the United States there are approximately 70,000 cases yearly. Over 30,000 cases were reported in the registration area during 1914. In many of the Western states smallpox

is present continuously. From 1893 to 1898 the number of deaths from smallpox in Russia, including Asiatic Russia, was 275,502. In Spain, during the same period, there were nearly 25,000 deaths, and Hungary, Italy, and Austria each had about 10,000 deaths. Smallpox is still rampant in the Far East and the severity of the disease and its highly infectious nature is similar to that of a hundred years ago in Europe. Epidemics have been recorded in Illinois as recently as 1901–02; in St. Paul, 1899–1900; in Michigan, 1912; in Topeka, Kansas, 1911; in London, 1901–02, and in Montreal, 1902.

Vaccination. While it is true that general sanitation and hygiene have improved greatly, this improvement has not materially affected the mortality curve of measles, whooping cough, and scarlet fever, which can be fairly compared to smallpox both in their method of transmission and their infectiousness. One factor, and one factor alone, has brought about this prodigious change in the so-called civilized countries. That factor is vaccination. Everywhere the prevalence of smallpox is in direct proportion to the frequency of vaccination. In well-vaccinated Germany smallpox is practically unknown. In the United States about one-tenth of the population is unvaccinated, hence the 70,000 cases yearly. This failure to be vaccinated is not peculiar to any one class of the population, since five per cent of the students in the first year at Harvard College are unvaccinated. Furthermore, there is no record of a single instance where thorough vaccination did not completely stop an epidemic.

The story of vaccination is an interesting one. Although discovered in the last years of the eighteenth century, it was not understood at all until the work of Pasteur over fifty years later. Even to-day, in spite of the extensive use of vaccination, we do not know

the actual infective agent of either the vaccine or smallpox. But the statistics of over a century have demonstrated its efficiency, although we are denied full knowledge of its action. The efficiency of vaccination against smallpox has been so striking that the discovery of other vaccines equally effective against other scourges has been the dream of many medical scientists and the goal of their labors. Pasteur believed that, since each infectious disease is caused by its own peculiar organism, there could be a vaccine for each disease. Pasteur himself developed an effective vaccine against anthrax and another against hydrophobia (rabies), which protected even after the disease had gained entrance. Since his time we have obtained a vaccine against typhoid fever. Nevertheless the most applicable and most effective vaccination which we have to-day is that against smallpox.

The principle of vaccination is simple in the extreme. A single attack of certain diseases confers on the victim an immunity for life against that disease. This principle has been recognized since the earliest times. Frequently in the past, and occasionally even to-day, parents deliberately expose their children to mild cases of certain diseases. Since, to their mind, the child must almost inevitably contract the disease, it is better to contract a mild attack and secure immunity than to run the risk of a later and more severe attack. Unfortunately, while there are frequently mild epidemics of any disease, it does not follow that the disease deliberately contracted from a mild case will be mild. In addition such a practice spreads the disease. Smallpox has been contracted deliberately in this way for this purpose from the earliest times. Centuries before Christ this was a common practice in China and India. The procedure usually consisted in taking a pustule of a patient with a mild form of smallpox and transferring

that pustule to a scratch on the arm of a second person. This practice was known as inoculation. Inoculation was passed from one inoculated person to another. Obviously, in such a procedure, other diseases besides smallpox could also be transferred. But the practice of inoculation had much to commend it for the resulting mortality was less than one per cent, while the mortality from virulent smallpox was many times higher.

But inoculation, though effective, actually spread smallpox in a mild form and some of the cases became virulent and started severe epidemics. In 1770 Edward Jenner heard a farmer's daughter say, on being told that smallpox had broken out in the neighborhood, "I cannot take that disease for I have had the cowpox." Dairymen had noted that persons infected from sores on the udders of cows, known as "cowpox", escaped smallpox. Jenner substantiated this belief by careful statistics, and on May 14, 1796, he did his first vaccination on a lad with virus taken from a sore on the hand of a milkmaid accidentally infected while milking a cow. The boy did not take smallpox, although he was repeatedly exposed to the disease. In 1798 Jenner published his work.

Vaccination was introduced into America in 1800 by Dr. Benjamin Waterhouse. He vaccinated his children and sent them into a smallpox hospital, thus establishing the fact that they resisted the disease.

Since 1800 vaccination has been carried to all parts of the world and always with the same result, — the eradication of smallpox. The collected statistics and the attendant researches have told us much about smallpox and vaccination, and the following facts are now well established. Vaccination to be effective must "take", *i.e.* must leave a typical scar. After a successful vaccination the person is usually completely

immune for a period of years, averaging seven to ten. If the disease is contracted, it will be mild and with a low mortality. Vaccination and re-vaccination after about ten years will give immunity for life. Laboratory investigations have shown that cowpox is really identical with smallpox, being only a mild modification of smallpox. Vaccination from animals like calves is much preferable to transfer from human being to human being. Calf vaccine cannot transfer most of the human diseases, since the calves are not susceptible to them, this being particularly true of syphilis. If the calves are properly cared for and are subjected to the tuberculin test, the danger of the transmission of bovine diseases is eliminated.

Since in the United States the Public Health Service inspects all vaccines, there is great security in their use. In Massachusetts a wise State Board of Health has for years furnished free a pure vaccine virus of its own make. The vaccination scratch is, of course, subject to the same infections as any other scratch, but the use of the usual surgical precautions will remove any danger of infection. Statistics of vaccinations under every and all circumstances show one fatal infection to 65,000 vaccinations. In the Philippine Islands, however, 3,500,000 persons were vaccinated without a death.

Strange to say, in the face of this evidence the anti-vaccinationists and anti-vaccination societies exist. The opponents of vaccination generally dwell on the following points. In the first place they point to the large use of animals and object, further, to the administration of disease material from animals to human beings. It may be granted that the use of animals for such purposes may be repugnant and can only be justified by public necessity. Confessedly it would be much better if the vaccine virus could be prepared

in a test tube, but that is impossible at present. Likewise, no one is vaccinated by choice, but it is necessary for the community, and most people, therefore, submit with good grace, particularly in view of the negligible danger and the enormous protection afforded.

The second point brought up by those opposed to vaccination deals with the dangers of the procedure. Cases of syphilis, tuberculosis, tetanus, and other infections are recounted. The answer is simply that the careful use of a proper vaccine virus is attended with no dangers. Gross carelessness will infect the scratch wound, but, at the worst, the danger is less than that from scratches from pins and splinters.

The third point questions the accuracy of the statistics and the efficacy of vaccination. Emphasis is laid on the improvements in hygiene and sanitation. It is true, due partly to the activity of those opposed to vaccination, that vaccination is imperfectly carried out in most countries. But we have in Germany not only vaccination properly carried out but also an illustration of the uselessness of other methods in combating smallpox. At first smallpox was combated in Germany by rigid quarantine, isolation, and disinfection with the best German thoroughness. Nevertheless smallpox raged as before. In 1874 Germany passed the vaccination and re-vaccination law which required vaccination at birth and then again in the early teens. The result has been no epidemics and very few fatalities, and these almost exclusively among immigrants who had never been vaccinated. In the German army up to the time of the European War there had been only two deaths from smallpox since 1874, and one of these had never been vaccinated successfully. It is instructive to contrast the conditions where vaccination is enforced and where anti-vaccinationists are influential. From 1901 to 1910

there were in all Germany only 380 deaths from smallpox and most of these cases came from outside, but during the same period in England and Wales with half the population of Germany there were 4,286 deaths from smallpox. Statistics fail to show any great reduction in measles or scarlet fever which are transmitted like smallpox and which are, on the whole, less infectious.

The vaccination history of the victims of any epidemic of smallpox always makes interesting reading although it is always monotonously the same. In an epidemic in Chicago, 1899–1901, there were 310 cases of the disease. Of these, 271 had never been vaccinated successfully; only five had typical scars; the other scars were doubtful. The most recent vaccination of the thirty-nine who had been vaccinated was sixteen years before. We have, further, the evidence of the doctors and nurses who care for smallpox patients and never contract the disease, since they are always well vaccinated. Doctors and nurses, who care for measles and scarlet fever and who are not immune through previous attacks, not infrequently contract the disease in the course of their duty.

In most civilized countries the story of smallpox is something as follows. There are vaccination laws which a proportion of the population obey, — in the United States about nine-tenths. The vaccinated nine-tenths generally protect the unvaccinated one-tenth. Re-vaccination and, in some cases, vaccination, is only done at times of epidemics. The result is that smallpox is constantly with us. If vaccination and re-vaccination were carried out among our population and all immigrants were vaccinated, smallpox would disappear from this country. But man's nature is such that he is forgetful of anything beyond his present troubles. Even incomplete vaccination has

protected him from a widespread scourge. Hence the tendency is to relax our already somewhat inadequate vaccination laws rather than to stiffen them.

This lamentable tendency gained such headway in England that not only were the vaccination laws rather overlooked, but the supporters of vaccination were subjected to violent personal abuse. Finally, in exasperation, Sir William Osler, long a foremost physician in the United States and now Regius Professor of Medicine at Oxford University, made the following statement in the course of an account of the benefits to man of science:

"I would like to say a word or two on one of the most terrible of all acute infections, the one of which we first learned the control through the work of Jenner.

"I do not see how any one who has gone through epidemics as I have, or who is familiar with the history of the subject, and who has any capacity left for clear judgment, can doubt its value. Some months ago I was twitted by the editor of the Journal of the Anti-vaccination League for 'a curious silence' on this subject. I would like to issue a Mount Carmel-like challenge to any ten unvaccinated priests of Baal. I will go into the next severe epidemic with ten selected vaccinated persons and ten selected unvaccinated persons. I would prefer to choose the latter, — three members of Parliament, three anti-vaccination doctors, if they can be found, and four anti-vaccination propagandists. And I will make this promise — neither to jeer nor to jibe when they catch the disease, but to look after them as brothers, and for the four or five who are certain to die I will try to arrange the funerals with all the pomp and ceremony of an anti-vaccination demonstration."

Needless to say that this challenge which sums up so excellently the case for vaccination has never been answered.

CHAPTER XIII

Diseases Transmitted by Contact

The group of contact diseases includes those in which the avenue of entrance of the disease is at the point of contact, usually the skin, more rarely the mucous membranes. It is possible to propagate by contact with the mucous membranes of the mouth most of the infections usually transmitted through the air, mainly by droplets, and some of the infections usually transmitted in food and drink. In the first instance the avenue of infection is, in the main, from and to the respiratory tract; in the second case, the avenue of infection is from and to the digestive tract. But there are a number of infections in which the precise method of infection varies, although it is characteristic of them that the avenue of entrance is through the skin or, rarely, through the mucous membrane.

Local Sepsis

Boils, for instance, are transmitted only by the direct implantation of the particular organism within the skin. Boils are caused by a micrococcus, the staphylococcus. These staphylococci are common organisms which are constantly on the surface of the skin awaiting a chance to get deeper into the skin and cause a lesion, which, if small, is a pimple, if larger, is called a furuncle or boil, and, if still larger, is known as a carbuncle. Boils simply represent one type of

skin infection which is spread only by contact. The infection in these cases is usually carried into the deeper structures along the hair follicles. The pus from these boils contains many organisms and the infection may be carried from place to place in the same person or to another person. The intact skin offers no avenue of entrance, but small abrasions are very common, especially at the hair follicles. The resistance to these skin infections varies widely in different individuals and in the same individual at different times. A large number of skin infections are spread in the same way as boils. "Red flap" is caused by a ringworm which is really a vegetable bacterium. This disease is highly contagious by contact. The same is true of all the parasitic skin diseases. These conditions have already been discussed in the chapter relating to the hygiene of the skin.

Many diseases are caused by contact through wounds, which include not only the wounds in accidents, but also those from surgical operations. Before the time of Pasteur, surgical operations were usually followed by infections. Now we have almost eliminated infection after surgical operations. Childbed or puerperal fever, now happily nearly extinct, is due to the introduction of bacteria into the womb, usually by hands or instruments. The deaths after criminal operations are usually due to the use of unclean instruments.

We are all familiar with the formation of pus or matter after pin-pricks and abrasions of the skin. Usually such conditions are not serious, but general sepsis or blood-poisoning, as it is often called (not to be confused with the blood-poisoning of syphilis), may result. A neglected pin-prick, a crack in the skin of the foot, which is infected, the paring of corns with an unclean instrument have all resulted in the loss of

limb or of life from general sepsis. The bacteria may be present on the skin. But the hands and the finger-nails are almost constant carriers of these pus organisms unless they are carefully cleaned.

In general, all breaks in the skin surface must be regarded as possible avenues for the entrance of the ever-present pus micro-organism. Dirt may contain these micro-organisms. They may be present on all cutting instruments and they are almost invariably present on the hands and under the nails, except just after washing. All these skin lesions are catching and should be so regarded. Scrupulous cleanliness, especially when touching breaks in the skin surface, is the best prevention. Such cleanliness is best obtained by the vigorous use of soap and water. Alcohol is a good disinfectant for the hands, while corrosive sublimate is also of some value. But the main reliance must be placed on the mechanical removal of dirt and bacteria.

Tetanus

Certain types of bacteria are particularly associated with dirt and wounds. One of these micro-organisms is the bacillus which causes tetanus or lockjaw. This disease has been known for many centuries as one that occasionally follows wounds, but it was not until 1884 that it was discovered in animals, and in 1885 that it was reproduced in animals. Not until 1889 was the bacillus obtained in pure cultures.

Tetanus is found everywhere in the Tropics and in the Temperate zones. The bacilli of tetanus are found in the earth. They grow only anaerobically — that is, only in the absence of air. This explains why tetanus is apt to follow punctured wounds like those caused by stepping on a rusty nail. The common sites of infection in the disease are the hands and feet. In 863

cases the gateway of infection was in 266 cases in the hands, and in 280 cases in the feet.

Before the introduction of tetanus antitoxin serious complications after gunshot wounds of the extremities and in Fourth of July hand injuries were frequent. When blank cartridges were a common feature of our national birthday celebration there was an annual toll of several hundred deaths from tetanus. In 1903 out of fifty-six cases of so-called Fourth of July tetanus which were treated without antitoxin sixteen died, whereas in 1904 out of thirty-three cases treated with antitoxin none died. Happily legislation, publicity, and tetanus antitoxin have now almost entirely eliminated the deaths from tetanus after the celebrations of the Fourth of July.

The conditions in the European War were favorable for the prevalence of tetanus, as the micro-organisms were in the soil and punctured wounds were common. But the use of antitoxin almost entirely prevented the disease. Whenever soldiers are wounded, they are at once given a dose of antitetanic serum. The general opinion is that, unless the antitoxin is given before the fixation of the toxins in the nerve cells takes place, it is of little, if any, value. To be effective, therefore, it is usually necessary to give antitetanic serum as soon as possible after any deep wound, contaminated by dirt, is received and before the disease develops.

Rabies

Rabies or hydrophobia has been well known for centuries. We find the first record in Aristotle, who wrote, "Dogs suffer from madness that puts them in a state of fury, and all animals which they bite, when in this condition, become also attacked by madness."

There are also references to this madness in the works of Virgil, Horace, Ovid, and Plutarch. The presence of the disease in human beings, after dog-bite, was recorded in the first century A.D. Toward the end of the eighteenth century the disease had spread all over Europe and was also present in America. Rabies now exists in almost every country except in Denmark, Sweden, Norway, England, and Switzerland where effective muzzling of dogs has stamped out the disease, and in Australia where a strict quarantine of six months is enforced on dogs. The disease has been constantly present in the United States and a considerable number of deaths occur from it every year, 111 in 1908.

Rabies is transferred by the bite of a rabid animal. The domestic dog is the usual animal to transfer the disease to man, but most of the other animals are subject to the disease. If rabies once develops in the system, the mortality is one hundred per cent. Fortunately not every person bitten by a mad dog contracts rabies. The percentage is, perhaps, ten per cent.

Pasteur's work on rabies has given us an unusual means of preventing the disease. Under his treatment the mortality from the disease has been reduced to a fraction of one per cent. This discovery by Pasteur was one of the most striking in the history of medicine. On the news of his success in treating rabies people from all parts of the world at once went to Paris for treatment, and now there are Pasteur Institutes for the treatment of rabies in almost every country. Rabies is a peculiarly horrible disease; the symptoms consisting of delirium, mania, violent reflex spasms of the mouth and larynx with inability to swallow make a picture barely to be imagined. The terror which the words "mad dog" arouse in the popular mind has a complete basis in fact. Since some months usually

elapse between the time of the bite and the onset of the symptoms, dread expectancy increases the terror of this fatal disease.

Curiously enough, it was not until means were discovered for preventing and controlling the disease by the Pasteur treatment and muzzling and quarantining dogs that there was any dispute concerning the existence of rabies. The symptoms and results of mad-dog bites were commonplaces in the literature and folk lore of most peoples. But since the introduction of the Pasteur treatment, a body of sentimentalists have made a vigorous campaign against the treatment as it necessitates the use of animals to produce the virus. These people have carried their enthusiasm to such extremes as to deny the existence of the disease. People with such oversentimental minds have also protested vigorously against the muzzling of dogs and any effort to make muzzling effective always meets with great opposition. As a matter of fact, wherever the muzzling laws have been enforced effectively, the number of cases of children bitten by dogs has been decreased, together with a marked decrease in the cases of hydrophobia. This was well illustrated by the experiences in England. In 1889 there were in England 312 cases of rabies and in 1892 the number of cases had dropped to thirty-eight, — this was under the enforcement of muzzling the dogs. Then the sentimental friends of the dogs succeeded in having the "cruel muzzle" removed. As a result, in the next five years, fifty-one people died of the most agonizing death known to medical science. In 1895 there were 672 cases of rabies. The authorities soon concluded that the condemnation of human beings to horrible death rather outweighed the feelings of the dogs at having to wear muzzles, so that the law was strictly enforced. As a result rabies has disappeared from England and is

kept out by a strict quarantine of six months against any and all dogs.

As for the statement that the Pasteur treatment causes rather than cures rabies, the figures in the decrease of the death rate should be a sufficient answer. While other animals than dogs may be bitten and become rabid and transmit the disease by biting, prevention of rabies is chiefly directed toward the dog. Adequate muzzling laws and the early application of the Pasteur treatment in all persons bitten by a rabid dog or a dog suspected of rabies will practically eliminate the disease in human beings.

Hookworm Disease

Hookworm disease is of immense economic importance in the districts where it is prevalent. The anemia and so-called laziness which it causes have been the determining factor of much of the poverty, mental backwardness, and disease which has prevented industrial and social progress among the people who are its victims. In the Old World, hookworm disease was probably known nearly 3,500 years ago, but the cause, an intestinal parasite, was not shown until the middle of the nineteenth century. In the United States no authentic case of the disease was recognized as such until 1893, and between 1893 and 1902 only thirty-five cases were diagnosed. Since the latter date, however, the hookworm disease has been understood more accurately and it is now recognized that some 2,000,000 people in the United States, mostly in the Southern States, suffer from this malady. The greatest number of sufferers are between the ages of five and fifteen, and in some of the southern schools thirty to eighty per cent of the pupils are infected. In certain colleges thirty per cent of the students were found to be infected.

The disease has an extensive range, for it is found in all parts of the Tropics and belts the world in a zone sixty-six degrees wide from Parallel 36° North to 30° South. Practically all the countries between these parallels are infected with the disease.

Hookworm disease in the Southern United States is due to the so-called "New World Hookworm", a parasite which differs slightly from the Old World Hookworm. The disease manifests itself as extreme lassitude or general inertia.

When the hookworm disease was first studied carefully, it was found that these tiny blood-sucking worms were in the intestines of the patients. The worms could be recognized easily in the stools, either as eggs or as the worms themselves. It was first believed that the worm entered the intestinal tract through the mouth, but it was then found that many of the people who suffered from the disease were accustomed to go barefoot and had a skin affliction called "ground itch." The eggs of the worm, after discharge from the intestinal tract of an infected person, get into the skin, usually of the foot. The eggs then get into the circulation and the worms develop in the intestines. Probably ninety per cent of the cases are due to skin infection, and the remainder are taken in through the mouth by means of contaminated water and food or dirty fingers. The supply of shoes to the barefooted poor whites and negroes and the introduction of the sanitary privy have done much to reduce the dangers of infection and have markedly decreased the disease.

The hookworm disease is a relatively easy thing to control and cure. Drugs, in sufficient doses, will kill the worms and cure the disease. Education in personal cleanliness, the widespread introduction and use of the sanitary privy, the wearing of shoes, and general sanitary measures are necessary to reduce the areas of infection.

CHAPTER XIV

The Venereal Diseases and Sex Hygiene

The venereal diseases, next to tuberculosis, are the most common of the communicable diseases which affect mankind and their danger to the public health and to the race makes them one of the greatest problems of preventive medicine. The venereal diseases are included under those transmitted by contact (usually but not always by sexual contact), and are three in number, syphilis, caused by the spirochæta pallida; gonorrhea, caused by the gonococcus, and chancroid, caused by the chancroid bacillus.

Syphilis

The History of Syphilis. The history of most diseases fades back into the distant past, but the history of syphilis begins abruptly in 1494, two years after the discovery of America. Syphilitic bones, presumably, but not positively, of the pre-Columbian age in America, and Spanish documents indicate that syphilis was introduced into Europe from Haiti by the sailors of Columbus. In 1494 the army of mercenaries collected by Charles VIII, of France, invaded Italy. With this invasion syphilis appeared. As the soldiers scattered, syphilis swept over Europe in a rapidly increasing epidemic, and, before the year 1500, syphilis had invaded all of Europe and had appeared in India.

The first epidemic was of extraordinary severity, a

severity which is essentially a characteristic of the introduction of a new disease. In this first epidemic syphilis frequently ran an acute fatal course, as is evidenced by the drastic measures taken against it. Aberdeen, Scotland, and Paris passed stringent laws banishing all those afflicted with this new plague. Within the next hundred years, however, syphilis took on the essential characteristics which we recognize to-day. On account of the prevalence of syphilis throughout the world, a vast literature concerning the disease grew up, and the clinical facts concerning it became well known. But only since 1905, the date of the discovery, by Schaudinn and Hoffmann, of the causative agent of syphilis, the spirochæta pallida, have we acquired the mass of exact information concerning syphilis and its treatment such as we possess in the case of no other disease.

Syphilis is a disease peculiar to man and is acquired in from ninety to ninety-five per cent of the cases through sexual contact. Infection with syphilis requires a break in the skin, although this break may be microscopic. The so-called initial lesion, or chancre, appears where the infection is actually received.

The Course of Syphilis. The chancre (initial lesion or primary sore) appears slowly and usually painlessly after an incubation period of about six weeks. The chancre, since the disease is usually acquired by sexual contact, is usually on the sexual organs. Next in order of appearance, some weeks later, is a rash. This coincides with the general invasion of the body with the spirochætæ. There may also be sores in the mouth, enlarged glands, and fever. This stage, when uninfluenced by treatment, may last for weeks and months. This so-called secondary stage may or may not be followed by localized inflammatory lesions which are called gummata. The so-called tertiary stage

merges into the stage of the end results of syphilis, — arterio-sclerosis, aneurysm, tabes (locomotor ataxia), and general paresis. Usually the chancre, particularly in men, can be detected, but any or all of the other stages of the disease may not be apparent in an individual case. Then, too, the signs of syphilis, active and infectious, may be evident to the physician, but unsuspected by the victim. This is especially true of women, who may be entirely ignorant of the fact that they have the disease. It is generally conceded, but not positively proven, that one attack of syphilis prevents reinfection. Reported instances of reinfection are to be explained as recrudescences of the original infection.

The Dangerous Lesions of Syphilis. All the lesions of syphilis, even aneurysm and locomotor ataxia which often appear years after the infection, are caused by the actual invasion of the tissues by the spirochætæ. But syphilis is transmissible only when a syphilitic lesion comes into direct or indirect contact with another person. If the spirochætæ are confined to the brain, for example, they cannot transmit the disease. Hence the primary and secondary lesions are practically the only infectious lesions. In the secondary stage, in which spirochæta-containing lesions are present on the skin and on all the mucous membranes, syphilis is particularly dangerous. This is the stage in which doctors, nurses, innocent members of the family, and friends are most liable to be infected while performing their professional duties or by the use of common utensils.

From ninety to ninety-five per cent of the cases of syphilis in adults are acquired through sexual intercourse. This includes the infection of the innocent partner in the legitimate relations of marriage as well as infection in illicit intercourse. The great source of syphilis is, of course, illicit sexual intercourse. The

female partners of such irregular relations may be either frank or clandestine prostitutes. Statistics show that from eighty to eighty-five per cent of prostitutes contract syphilis during their career and usually fairly early. This means that practically all prostitutes are syphilitic, but that they are not necessarily in the stage of the disease in which the infection is transmissible. It has become fashionable to say that syphilis in one-half the cases is acquired innocently. In such a statement innocent syphilis includes all congenital syphilis, all extra-genital chancres, even when acquired during illicit intercourse, and one-half of the double infections of the legal partners. Such general statements as to innocent syphilis require qualification in order not to alarm unnecessarily the public concerning the dangers of acquiring syphilis in other ways than by sexual intercourse.

Transmission of Syphilis by Indirect Contact. The spirochæta is of very short life (a few hours at the most) outside the body, and furthermore the spirochætæ are easily destroyed by any of the common antiseptics. Transmission of syphilis by the common use of pipes, drinking cups, and utensils is not uncommon, but transmission in food or by waiters, an example of common belief concerning the disease, is almost unknown. In general, the indirect transmission of syphilis is excessively rare, except among people with extraordinarily uncleanly habits. The penalty of contracting syphilis is so great, however, that all reasonable precautions should be taken. But persons of clean personal habits need have little fear of contracting syphilis indirectly. The transmission of syphilis is direct, but in five to ten per cent of the cases the direct contact is not sexual intercourse.

The extra-genital chancres, which appear when syphilis is contracted in contact other than sexual inter-

course, may occur anywhere on the body, but they are most frequent on the hands, face, or mouth. The moist lesions of the mouths of syphilitics are the most usual source of the infection. Kissing is, perhaps, the common way in which the infection is thus transferred. Then, too, doctors and nurses not infrequently contract syphilis on the fingers or hand in the course of their professional duties.

Hereditary or Congenital Syphilis. Hereditary syphilis means that the syphilis of the child was transmitted by the mother in the uterus. The mother must be syphilitic, the father not necessarily so. A healthy child of a syphilitic mother may contract syphilis directly after birth. Hereditary syphilis has all the characteristics of adult syphilis, but, in general, the involvement of the organs is much greater and the disturbance of health is more severe. Not infrequently the fœtus dies and miscarriage occurs. Syphilis is one of the great causes of spontaneous miscarriages. The child may be born with the active disease and, in such an event, usually dies. But the disease may only manifest itself later in life, though nearly always before the age of puberty. Congenital syphilis may cause retarded development of the body, and infantilism, or again damage to the nervous system, including idiocy. Characteristic deformities of the bones and teeth are common in congenital syphilis, and the eyes and ears are frequently affected. Deaf-mutism may be of syphilitic origin. Despite the popular belief, there is no evidence of the transmission of syphilis to the third and fourth generations.

Frequency of Syphilis. Syphilis affects all classes of society. From the nature of the disease it is impossible to ascertain with any degree of accuracy the prevalence of this infection. The estimates of the best authorities show that about five per cent of the adult

males in the United States acquire syphilis and that the percentage is probably higher in Europe. There are probably five male syphilitics to one female. There is ground for the belief that syphilis is not on the increase.

The Effects of Syphilis. Except in the hereditary form, syphilis in its active stage rarely causes death. Few syphilitics are even compelled, during the active stage of the disease, to give up business or to suffer much inconvenience. It is the late effects of syphilis which interfere with life and health. These late effects may manifest themselves within a few months or only after twenty or even forty years. We have also learned through experience to associate certain general conditions with syphilis, as it seems to be an important factor in many cases of premature old age, early arteriosclerosis, and general organic degeneration. It is impossible to estimate with any degree of accuracy the prevalence of these late results. Many of these lesions have only recently been discovered to be syphilitic. Again, the efficiency of treatment does much to reduce the frequency of the late complications and only recently have we had the knowledge and the means for thorough treatment.

Syphilis is particularly prone to affect the nervous system. Older statistics gave this frequency as one to three, but the majority of these were, perhaps, remediable, in the light of our present knowledge. The statistics of the future will undoubtedly show a much lower incidence. Nearly ten per cent of all admissions to hospitals for the insane have an incurable brain disease due to syphilis — general paralysis of the insane, or general paresis. This comes on usually from six to ten years after infection. More persons in New York City die of general paralysis than of typhoid fever. Out of a group of female prostitutes 1.3 per cent

developed this incurable brain disease and 4.7 per cent of a group of male syphilitics. Patients with general paresis often live for years. They may be entirely harmless and may not require confinement, but enormous numbers of them have to be restrained at public expense in public institutions for the protection of the community. Consequently, syphilis must be regarded in part as an economic problem as well as a medical and social problem.

Tabes (locomotor ataxia) is, in all its modifications, a relatively common disease and the end result of syphilis. Tabes frequently causes industrial incapacity, and we find many tabetics in almshouses and the community hospitals for chronic disease. Here, again, we see the economic aspect of the problem.

Syphilis is a frequent cause of heart disease, of arteriosclerosis, and of aneurysm. The ravages of syphilis do not spare any tissue of the body, but we see its most disastrous, as well as its most common, effects on the nervous system and the cardiovascular system.

Carefully tabulated life insurance statistics show that the acquisition of syphilis generally shortens life about five and a half years. Many syphilitics, of course, indulge in other excesses which tend to shorten life. Probably a goodly proportion of syphilitics, who secure early and efficient treatment and who lead wholesome lives, live out their allotted years.

The Treatment and Cure of Syphilis. Despite the popular pessimism in regard to the cure of syphilis, it is now essentially a curable disease. Experience shows that even without treatment syphilitics apparently occasionally recover completely. With treatment the proportion of recoveries is much higher, for we are peculiarly fortunate in possessing a variety of agents which facilitate effective treatment of syphilis.

In the first place, since 1905 we have known the causative agent of syphilis, an organism which is present and demonstrable in syphilitic lesions. Whereas formerly it was often necessary to await the development of the typical secondary stage after the appearance of the chancre, now the diagnosis can be made in the beginning. In favorable cases prompt treatment probably aborts the disease. It is axiomatic that early diagnosis is essential, not only for the treatment and cure, but also for the control of its future dissemination.

Secondly, since 1906–07 we have had a reliable blood test, known as the Wassermann reaction. This complicated and only partially understood test was first described by Wassermann, Neisser, and Bruck. For the requirements of the test a small amount of blood, usually from the arm vein, is taken from the patient. The reaction involves the interaction of substances of this blood with the blood of a guinea pig, the blood of a specially treated rabbit, sheep's blood corpuscles, and a chemical substence sometimes, but not necessarily, derived from syphilitic tissue. This complex reaction has been of tremendous assistance. It is not present in the primary stage when the disease is local and when the disease may be recognized by finding spirochætæ, but it is almost universally present in the active stages of syphilis, and usually present even when the syphilis is latent. By means of this reaction the probability of the persistence of internal syphilis can be established even in the absence of external signs. It has also enabled the classification of obscure manifestations as syphilitic. But of greater importance is its relation to treatment. While even the most energetic treatment may not bring about a negative reaction, and treatment may be necessary in the face of a negative reaction, yet, roughly, intelligent treatment is only

possible when controlled by this reaction. Other tests of less, but of distinct, value are applicable to the examination of the spinal fluid for syphilis of the nervous system.

Therapeutic Agents. Potassium iodide and mercury have long been known to be of value in the treatment of syphilis, mercury, in particular, being of the greatest value. But both fade into comparative insignificance beside Ehrlich's great discovery, in 1909, of arseno-benzol or Salvarsan. This arsenical compound is usually called " 606 ", since that was the 606th drug tested in the series of experiments. This research by Ehrlich deserves special mention since he deliberately set to work to find a combination of arsenic which would destroy parasitic substances in the blood and yet be harmless to the human organs. Arseno-benzol represents the beginning of chemotherapy. While subsequent experience has not confirmed the earlier hope of a complete cure by a single dose, yet the administration of arseno-benzol in repeated doses and in conjunction with mercury, when controlled by the Wassermann reaction, is remarkably effective in the cure of syphilis.

It is evident that no drug can replace destroyed tissue and experience shows that general paresis cannot be cured. The later the stage in which treatment is begun, the less favorable the chances for complete cure. In the early stage, when the disease is largely local, complete cure is nearly certain. In the secondary stage, failure to cure ought to be very small, about one per cent. It is probably impossible to guarantee a cure, for, despite all treatment, an unknown small percentage will develop organic brain and arterial disease. The importance of early diagnosis cannot be overemphasized. It is unfortunate that many syphilitics, conscience stricken by this manifestation

of irregular living, decide to obtain inadequate treatment from such incompetent sources as newspapers, quacks, and the corner drug store. In point of fact their family physician is too conversant with the irregularities of human conduct and the prevalence of syphilis in all walks of life and too appreciative of the importance of energetic treatment to bother overmuch with moralizing reproaches. In not securing, at the first appearance of any suspicious lesion of syphilis, the most competent advice, the individual may lose the benefit of the probable certainty of cure. In addition it is not uncommon, unfortunately, for the unwise confession of syphilis to lead to blackmail.

From the point of view of the community and for the prevention of the spread of syphilis, early diagnosis and energetic treatment are of the utmost importance. Ordinarily the dangerous infective stage of syphilis persists for months, but by means of intensive treatment the infectious period can be shortened to as many weeks or less. This means the elimination of many cases. It necessitates, however, in many instances free examination and free treatment. Largely on moral grounds such examinations and such treatment are not now readily available. The justification of such expenditures of private and public money can be made, however, not only in the increased protection of the community against disease, but also in the actual saving of money which will eventually result in the prevention of a large proportion of organic diseases of the arteries and of the brain of syphilitic origin. The victims of these diseases must eventually be cared for by public money in hospitals, almshouses, and insane asylums.

Syphilis and Marriage. The problem of the marriage of a syphilitic was formerly exceedingly complicated. Syphilis occurs most frequently in early adult

life, approximately at or just before the usual age of marriage, so that this is a question which is constantly present. The recent discoveries concerning syphilis, however, enable this question to be answered very definitely in the individual case and reasonably definitely in the abstract.

The dangers of the marriage of syphilitics are three: (1) the infection of the partner; (2) the propagation of syphilis to the children, and (3) the assumption of family burdens when that is not justified on account of impending disability of the syphilitic. The third point has been discussed already. The first two involve practically identical considerations, since the problem usually concerns males, and we know from studies of the Wassermann reaction that syphilis in the child necessitates syphilis in the mother. A reasonable rule is that a syphilitic may marry five years after infection, provided that he has been thoroughly treated during the first three years and has shown no manifestation of the disease during the last two years. And this rule holds despite the fact that he may have a positive Wassermann reaction. Under such conditions the former syphilitic will not infect his wife and he will propagate normal children. Syphilis, therefore, cannot be considered to be a permanent bar to matrimony, for experience has demonstrated the safety of such a rule of conduct.

Gonorrhea

The second of the venereal diseases is gonorrhea, caused by the specific micro-organism, the gonococcus. Gonorrhea is generally regarded as a local disease of the genital organs, but, while it may remain a local disease, its possible effects entitle it to much more serious consideration than it has received hitherto.

There are no statistics to show the prevalence of gonorrhea, but it is agreed that probably a majority of men suffer from it at some time in their lives. The disease is much less common in women. Since one attack of gonorrhea does not prevent a second attack, many individuals suffer repeated attacks. Like syphilis, gonorrhea is most common in early adult life and is inseparably connected with loose living.

In over ninety-five per cent of the cases gonorrhea is transferred by sexual intercourse. The exceptions are mainly two: (1) Gonorrheal conjunctivitis of the new-born, which the infant receives from the mother and which is a common cause of blindness; and (2) gonorrheal vaginitis in young girls, which occurs frequently in epidemics in institutions. The infection in young girls is transferred by the use of common utensils, like towels, and the general careless habits of childhood. Among adults gonorrhea is extremely rarely contracted in any other way than by sexual intercourse. The somewhat common belief to the contrary is founded on and fostered by the natural reluctance to confess to irregular living.

The clinical symptoms of gonorrhea usually appear from four to seven days after exposure. There is a strong tendency to spontaneous recovery, so that we have many so-called cures and many so-called "specialists in diseases of men." Among the laity the disease is lightly regarded as a trivial occurrence and is often compared to a "hard cold." Consequently little attention is too often paid to the disease. But the disease may become general and the patient die of gonorrheal sepsis. Gonorrheal rheumatism is not infrequent and this condition may be persistent and, in the end, crippling. Rarely, gonorrhea may be the cause of valvular disease of the heart. In men the infection may extend and lock off the outlet of the

testicular secretion. This does not interfere with sexual potency, but it does cause sterility. Sterility is commonly attributed to some abnormality in women, but twenty per cent of the cases may be traced to the effects of an old gonorrhea in the male. Stricture and the attendant complications also follow gonorrhea in the male.

The anatomy of the female favors the existence of the gonorrheal inflammation in the pelvic organs. Gonorrhea is probably the most frequent cause of inflammatory disease of the pelvic organs of women, which not infrequently cause mutilating operations involving the removal of organs. Sterility and chronic invalidism, even death, may be the end result. The disease is frequently hard to diagnose in women and, unlike the case with men, it may be unsuspected by the victim.

As long as an individual has gonorrhea, he or she may transmit the disease by sexual intercourse. Cure is usually achieved in men in the course of a few weeks, but it may be postponed for a long time. Attacks, after the first, are particularly persistent and chronic gonorrhea is notoriously obstinate. The cessation or diminution of the discharge is not proof of cure nor is the lapse of any given period of time. In women the course of the disease is more variable. Cure should always be established by competent medical advice, and it goes without saying that marriage is only permissible after positive cure. The failure to respect this rule of decency and commonsense may result in an invalid wife, a childless wife, or a blind child.

Chancroid

Chancroid, the third venereal disease, is due to a specific bacillus and causes superficial ulcers. The

disease is almost entirely local and it is transmitted in almost every case by the direct contact of sexual intercourse. In general, a much milder disease than syphilis or gonorrhea, the existence of chancroid depends on the same factors which obtain in the other venereal diseases. One attack does not prevent subsequent reinfection.

Sex Hygiene

Nature has taken care that the human race shall continue by implanting in each individual the instinct of sex to which, at some time or other, he will respond. The instinct of self-preservation is the only one which is more strongly a part of human nature, and it is a question whether the desire for existence is not, in a sense, secondary, in that it enables the individual to live and propagate his kind. But the presence of this powerful sex instinct does not necessarily mean that it must be gratified. Experience demonstrates conclusively that, contrary to the teachings of the licentious, sexual continence is detrimental neither to mind nor body.

The fulfillment of the sexual act was intended for the purpose of propagation, and our social structure depends for its protection on the restrictions of sexual intercourse to family life. General unrestricted sexual intercourse would completely revolutionize the foundations of life — foundations on which depend the purposes of Nature. As a result it is necessary to regard irregular living, in part at least, from the so-called moral viewpoint.

For the normal man or woman with the normal sexual appetite it is, perhaps, more convincing to look at the sexual problem from the viewpoint of health, not only the health of the individual, but also the health of the partner in the marital relation and of posterity. First and foremost of these considerations is the fact

that gratification of the sexual appetite outside of wedlock involves exposure to venereal disease. One can safely generalize by saying that the man or woman who breaks through social conventions by illicit intercourse for one partner, will break through for another partner. Such a generalization, often indignantly denied, especially for the duration of a particular " affair ", is frequently proven true by the man by the contraction of disease as well as by his own promiscuous conduct. Illicit intercourse leads almost inevitably to promiscuous intercourse and that means exposure to venereal disease. Exposure, however, does not necessarily mean disease, although most prostitutes contract syphilis and practically all gonorrhea. Infection, then, is a matter of chance.

A social order where sexual irregularities exist, but which are not recognized as fundamentally opposed to the order itself, has attempted to solve the problem of venereal disease by several prophylactic measures. The first attempt at prevention of the contraction of venereal disease is the regulation of prostitution, with a periodic medical examination of the prostitutes. Experience has shown that it is impossible thoroughly to carry out such regulation. The licensed public prostitute is so much of an outcast that clandestine prostitution is much increased by any such system. Women will only become licensed when they feel that they can no longer attract men by their personal charms and that the only remaining way of livelihood is through public announcement of their occupation. Again, the licensed prostitute may easily develop and spread diseases in the interim between examinations. On the whole, while licensed prostitution has its advocates, it must be admitted that licensed prostitution in any community has not appreciably lessened disease. Such a system gives a false sense of security to the offender

and encourages the development of illicit sexual habits which will inevitably bring disease.

Various methods of medical prophylaxis have been suggested to prevent disease in the male, and their use has been carefully studied in the navy. Without question the use of medical prophylactics has markedly reduced venereal disease, always a large problem in navies the world over. Yet conditions obtain in the navy which make the use of the prophylactic unusually effective. After exposure, within a few hours, the use of such measures is made obligatory. It has been amply demonstrated that calomel ointment, properly used, is a reasonably certain protection from syphilis, while the silver salts have a similar protective power against gonorrhea. But what the final attitude will be concerning the use of prophylactics against venereal disease is not clear, and this aside from any questions of morality. It is certain that under the special conditions of the navy, a considerable amount of disease is prevented for the time being. Prophylactic measures on a wide scale, however, cannot be accounted of real value even in the prevention of venereal disease, for the conditions of the prompt thorough use of such prophylactics are not easily obtainable or carried out. It is at least open to question whether general knowledge and use of prophylactics would actually decrease the mass of venereal disease. The disease actually prevented would in part be compensated for by additional disease acquired through an increase in irregular living inevitably favored by the sense of security from venereal disease, however false or difficult of attainment that security may be.

The Worry and Strain of Illicit Sex Indulgence. Venereal disease is not the only penalty of irregular living that is paid in terms of damage to the human system. The illegitimate child, the abortion — a

crime in law — with its dangers to life and health, the fear of pregnancy, the fear of exposure, bring the burden of worry mostly to the female partner, but the male carries his share. The man may pay the penalty of his so-called indiscretions in the publicity of the court room. Newspapers are filled with disclosures of private lives, but in reality very few get into print. As the general standards of morality have been raised step by step, the greater is the possibility of the man and woman of irregular lives being brought face to face with a dilemma of their own making, public disclosures and the results, or a life of secret worry. Worry acts deviously and insidiously. None are immune, although all are variably affected. The end results of worry are indirectly brought about, but they are none the less frequently serious. Irregular living inevitably means worry, and worry may be the determining factor not only for health but for actual material success in life. And this is quite apart from the effect of irregular living and the breaking of moral as well as legal laws upon the mental and moral fiber and tone of the individual.

Sex Habits. Irregular living with its attendant evils of venereal disease and worry may rightly be attributed to faulty sex habits. Habits of sex are formed as are other habits. There is the habit of continence as well as the habit of sexual indulgence. Illicit sexual indulgence, when persisted in, almost invariably leads to promiscuity. The man who thinks himself secure from venereal disease and worry in his intercourse with one partner is establishing a habit which will call for gratification when he is tired of his early partner or she is removed by circumstances. Then, too, the habit of sex gratification, once established, usually makes serious inroads on time and energy. Even business, or at least serious business, is subordinated to this

habit. The life and mind of such a person are on a sexual plane. Furthermore, the habit of sex gratification has evil attendants. The relation of alcohol to loose living is intimate. Alcoholic excess is often necessary to remove the restraint of reason from the sexual appetite, and it happens that some people, on this account, wilfully indulge in alcoholic excess.

While society has decreed sexual restraint on moral grounds, we find ample justification for such restraint on the grounds of health. Prophylaxis does not solve the problem of sex hygiene and, as a matter of fact, at least thus far, promises little for the prevention of venereal disease. Irregular living affects health quite apart from venereal disease. The associated worry and the other associated bad habits of body and mind which arise from faulty sex habits, while incapable of statistical proof, are capable of producing much harm to body and mind. The solution of sex hygiene is the acquisition of sound sex habits. Sound sex habits mean the exercise of the sex instinct in the marital state and, under all other conditions, sex continence.

Sex Perversions. There are other forms of sex indulgence and sex habits than those of sexual intercourse and these are grouped together as sex perversions. The most widely known of these is masturbation, an unnatural practice of both sexes. On account of the nature of this practice a habit is easily established. It is somewhat difficult to decide whether it is fortunate or unfortunate that most of the tales and popular conceptions regarding masturbation are false. These tales are terrifying because it has been the belief that the best method of procedure is to frighten the individual out of his perverted habit. The gossip of youth, the lurid advertisement, the instinctive reticence towards such matters, all conspire to distort knowledge covering matters of sex. Such a normal manifestation

as the periodic nocturnal emission of the continent male youth is distorted to mean sexual weakness. As a matter of fact the nocturnal emission is simply the more or less automatic relief of the overfilled sex organs. No definite interval can be fixed for its occurrence either in days, weeks, or months. But those who practice masturbation either sporadically or regularly are the particular prey to weird superstitions. The facts are relatively simple. The insane and feeble-minded masturbate because, on account of their insanity or feeble-mindedness, no appetite is restrained while there are means of gratification at hand. In the case of the sexual appetite masturbation is usually the most available means. This habit is the result and not the cause of the insanity and feeble-mindedness. It is actually questionable how much actual harm masturbation itself causes. But there is no question that the natural and inevitable revulsion of feeling, the disgust and sense of shame and self-degradation over this unnatural and indecent practice may entirely disturb the mental and nervous balance of the individual. This disturbance is greatly increased by ignorance, gross exaggeration, and deliberate perversion of the facts of sex hygiene. The victim of masturbation usually fears insanity, loss of will power, sexual impotence, and inability to marry. As a matter of fact the habit and its attendant train of evils usually disappear after simple explanations. The realization of the importance in Nature of the sex instinct and the removal of the bewildering fog of mystery and ignorance suffices for the cure of the habit of masturbation in the average healthy young adult.

Sex Education. The feeling is growing that ignorance is the cause of many of the sexual irregularities and of venereal disease. In order to be effective this ignorance must be dispelled before the age of eighteen

in the majority of cases. The facts of sex, of venereal disease, and of sex habits should be put before all young people. But education will not eliminate irregularities of sexual life. Even with all the available information, there will always be those who will deliberately choose to violate moral standards and to expose themselves to the physical and mental damage of irregular living. And there are only a few who do not bitterly lament when they incur the penalty which they knew in advance they were liable to incur.

It is highly important that these facts of sex and health should not be colored. A young adult, made suspicious of the truth of statements about sex, not infrequently decides to trust only to his own experiences. If the young adult is to learn by the experience of others, the account must be accurate and convincing. With the best intentions in the world many estimable people feel justified in perverting the truth about sexual matters, only too frequently with disastrous results. Much excellent literature has been published on sex hygiene, but too often it is easy to misinterpret the opinions advanced. The main responsibility for the elucidation of sex matters to the young people must fall on the parent, the guardian, and the doctor. Pamphlets, books, and lectures are often valuable adjuncts, but the problem varies in each boy and girl and the individual difficulty is better and only solved by a personal interview. The pamphlet read in secret may only serve to inspire or exaggerate morbid thoughts. Indeed, one of the greatest difficulties in the instruction on sex hygiene is to prevent the subject becoming unduly prominent in the minds of the youth.

Sound habits of living inspire other wholesome habits. The boy and girl with sound health habits usually need little encouragement to develop a sound habit of sex. Likewise, unwholesome habits of mind and body

furnish a favorable soil for the development of a faulty sex habit. Thus, overstudy, fatigue, insufficient exercise, as well as frank dissipation, may contribute to the formation of bad habits of sex.

The encouragement of out-of-door recreative exercise and athletic games finds an important justification in contributing to a healthy mind and body. Many a boy and girl find that physical exercise and sound physical condition eliminate the disturbance of the sex problem. Education and other wholesome health habits contribute the best basis for the formation of a good sex habit. Marriage, and particularly early marriage, represent to many people the best solution of the problem of sex. While marriage permits the exercise of the sex instinct for its original purpose, namely the propagation of children, yet the problems of sex are greater than the conditions of marriage and marriage *per se* does not solve the sex problem in every instance.

CHAPTER XV

The Insect-borne Diseases

The fourth large group of communicable diseases is made up of those which are transmitted by insects. In the diseases of this group, however, there is a slight overlapping into other methods of transmission. In the case of typhoid fever, for example, it is probable that flies play a certain role, but in the case of the important diseases of this group they are only transmitted by the bites of insects.

Yellow Fever

The conquest of yellow fever is one of the most dramatic accomplishments of modern medicine. Almost until the present day yellow fever has been the greatest scourge of many localities long inured to disease of many kinds. Yellow fever, in contrast to the other communicable diseases, spread over only a limited area. The earliest history of the disease comes from the followers of Columbus. When first known to white people the disease was confined to the shores of the Caribbean Sea and of the Gulf of Mexico in the Western Hemisphere. With the increase of transportation and communication yellow fever spread. Epidemics have occurred as far north as Quebec in Canada, in Wales in Great Britain, in Italy, on the West Coast of Africa, and as far south as Montivideo and Valparaiso in South America. But these epidemics always origi-

nated from some locality in which yellow fever was constantly present. At the time of the greatest extent yellow fever was constantly present only in the limited area bounded by Havana, the Canary Islands, the West Coast of Africa, Rio Janeiro, Brazil, Guayaquil, Ecuador, Panama, and Vera Cruz, Mexico.

For well over a hundred years yellow fever was practically constantly present in Havana and from this focus many portions of the civilized world were infected again and again. In the latter part of the eighteenth century yellow fever destroyed ten per cent of the population of Philadelphia. More than once it brought military expeditions to defeat through the frightful mortality among the troops. During the French expedition to Haiti in 1802, 22,000 out of 25,000 men died from yellow fever in one season. It is said that out of a population of 9,000 in Gibraltar in 1800, only twenty-eight escaped infection. In 1878 out of a population of 19,500 in Memphis, there were 17,600 cases, with 6,000 deaths. New Orleans had almost yearly epidemics of yellow fever or "Yellow Jack." The Isthmus of Panama was infected with the disease, and it was this rather than any lack of engineering skill which caused the failure of the French to complete the Canal. The French yearly lost one-third of their white force from this cause. During the occupation of Cuba by the United States troops in the Spanish-American war, the troops suffered as severely as the troops of a hundred years before.

Shortly after the Spanish-American war the real history of yellow fever was written. At that time the only known factors in regard to the disease were as follows. Yellow fever was always much more prevalent in the hot weather. A person who survived an attack of the disease was thereafter immune. Immunes were in great demand in the yellow fever districts, for the

mortality of the disease averaged about twenty-five per cent.

At the beginning of the American occupation of Havana the city was scrubbed and cleaned and the best known sanitary regulations were thoroughly carried out under military authority. And yet, to the dismay of the sanitarians and to the amusement of the Cubans, who had been seriously inconvenienced by this cleaning up process, yellow fever became more prevalent than ever. The result was the Yellow Fever Commission, constituted of Dr. Reed, as chairman, and Drs. Lazear, Carroll, and Agramonte, which began work in 1900. Within two years all the essential facts necessary to prevent the disease were discovered, but Lazear died of yellow fever, Carroll intentionally contracted the disease for experimental purposes, and a number of volunteers willingly exposed themselves to the disease under all conditions. From this exposure the usual proportion of those who contracted the disease died. These men voluntarily faced death, not in the excitement of battle, but in the quiet of a scientific laboratory. Since yellow fever was not transmissible to animals, proof of the method of transmission had to be secured from human beings. But these heroic sacrifices were happily not in vain, for they directly resulted in the saving of thousands of lives each year, in the prevention of enormous economic losses, and in the building of the Panama Canal.

The mosquito had long been under suspicion as the carrier of yellow fever, and the experimental work soon demonstrated that only one species of mosquito, the female stegomyia fasciata, transmits the disease. The patient with yellow fever has to be bitten within the first three days of the attack for transmission to be possible. After taking the blood, the mosquito does not transmit the disease until twelve days later.

After twelve days the bite of the mosquito seems to transfer the disease during the life of the mosquito. Yellow fever is transmitted in no other way, as was proved by the courageous volunteers, who spent weeks sleeping and living in rooms on the soiled bedding of recent yellow fever patients, without contracting the disease, always provided no stegomyia mosquito entered.

Since the disease is transmitted by mosquitoes and only by a certain species of mosquito, it is not remarkable that cleaning up Havana did not rid the city of yellow fever. As a result of the experimental work, attention was at once turned on the mosquito. The stegomyia is found from Parallel 38° south and north. The insect resembles somewhat the common culex mosquito of the Atlantic coast, but, on close examination, the stegomyia has white markings and stripes, which give it a general grayish appearance. The stegomyia mosquito never appears further north than Norfolk, Virginia, except by some unusual accident of transfer. The insect has little flying ability and is easily destroyed by a breeze. The stegomyia is essentially a house insect, with a short life, and it breeds rapidly during hot weather in rain-water barrels, cisterns, wells, and house-gutters.

Acting on these facts concerning the cause of yellow fever, energetic measures were taken in Havana against the mosquitoes in general and particularly against their breeding places. This meant the use of screens, especially about yellow fever patients. It meant the emptying or screening of all stagnant water, if that were possible, and the pouring of oil on any permanent stagnant water to destroy the larvæ of the mosquitoes. Fumigation with sulphur and other substances was found to be effective in killing mosquitoes in houses, particularly after a case of yellow fever. The result of these measures was almost incredibly prompt and

brilliant. The yearly toll of deaths from yellow fever in Havana was over 500. And there has been only one case since September, 1901!

In May, 1904, the United States took over the building of the Panama Canal, and, incidentally, the yellow fever of the Isthmus. Under the able sanitary supervision of Colonel, now Surgeon General, Gorgas, there has been no case of yellow fever in the Canal Zone since May, 1906.

The weapons for the control and elimination of yellow fever are readily available as the experience in Havana and in the Canal Zone shows. And yet the actual causative agent of yellow fever is still undiscovered! It is know to be extremely small, ultra-microscopic, as it readily passes through a fine filter. But the knowledge of the causative agent is not necessary for the eradication of the disease since we know and can control the means of communication.

Malaria

Malaria has been known for more than 2,000 years, both under its usual name which means "bad air" and under its many synonyms, as chills and fever and ague. Malaria is prevalent in all tropical countries and becomes less common in colder regions. In India, an example of a tropical country, the disease has killed millions, and in the United States there are probably a million cases of the disease, mostly in the South. While malaria, as a rule, is not fatal, certain forms are notoriously so. The disease shows little tendency to spontaneous cure and one attack does not prevent a second. In fact, after infection, many persons inadequately treated suffer at irregular intervals from malaria for the rest of their lives. It causes a large amount of invalidism and industrial inefficiency. For

many years a remarkable remedy, cinchona bark and its active principle, quinine, have been known, being introduced into England as early as 1649, but the essential facts of the disease, the infecting agent, and the method of transmission have been known only recently.

Just as yellow fever is transmitted by a particular mosquito, so is malaria transferred by a mosquito, the anopheles. Like the stegomyia, the anopheles mosquito has certain definite characteristics, among them long hind legs which cause the insect at rest to appear to be standing on its head. The anopheles is hardier than the stegomyia, but is not capable of long flights. The culex, the non-disease carrier, on the other hand, can fly for twenty miles. The anopheles is a country mosquito and breeds in fresh water where there are weeds and algæ. Experience, therefore, had rightly associated malaria with swamps, but it was not the air from the swamp, but the swamp as a breeding place for this one breed of mosquito. In order to destroy anopheles mosquitoes the same principles hold true as for the stegomyia. Only with the anopheles it is necessary to drain swamps, cut down underbrush, and oil large areas of stagnant country water.

The cause of malaria, which was discovered after the association of malaria with the mosquito, is a small animal parasite which goes through a definite cycle. There is one cycle for the human host, and another for the animal host. It is usually possible to demonstrate the malarial plasmodia in the blood of persons with malaria and the blood examination is a valuable means of making a correct diagnosis of the disease.

With a knowledge of these facts it would seem to be possible to stamp out malaria, but the reason for the contrary is a simple one. Yellow fever, which has been controlled, is a short fever and the patient is

infectious for less than a week and the mosquito must bite the patient during that time to transfer the disease. On the other hand malaria is a chronic disease. It is easy, during the dangerous few days, to isolate a person suffering with yellow fever and screen him from mosquitoes, because he is almost necessarily confined to bed with the illness. Such procedure is not possible with people suffering from malaria for many of them lead active lives and harbor the plasmodia for years, and thus may furnish infected blood to many anopheles mosquitoes. These insects have a wider range into the Temperate zone, are hardier, and their breeding places are more difficult to eliminate than is the case with the stegomyia mosquito. As a partial recompense for the difficulties of controlling malaria carriers and of exterminating the anopheles, we have in quinine not only a drug of remarkable value as a cure, but also as a prophylactic. Then, too, Salvarsan frequently has the same effect upon the malarial plasmodia as it has upon the spirochæta pallida. This drug goes through the body, searches out the malarial parasites, and kills them off without injury to the organs of the body. Quinine also attacks the malarial parasites and kills them. Thus we have a marked and specific action of a drug which can only be paralleled by the natural antibodies of the body. The prompt use of quinine in malaria will kill the plasmodia and eliminate a reservoir for the mosquito to tap and transfer. Furthermore, quinine may act as a preventive of the disease, although this statement requires some modifications. General Gorgas advocates the daily administration of five grains of quinine as a prophylactic in malarial districts.

In Havana before 1901 there were yearly between 300 and 500 deaths from malaria, reaching as high as 1,900 in 1898. By the use of various antimalarial measures,

proper screening, drainage or oiling of breeding places, intelligent use of quinine both as a curative and as a prophylactic, and the widespread use of blood examination for diagnosis, there were only four deaths in 1912. Malaria still exists in the Canal Zone, but it is under reasonable control. In 1906 over eighty per cent of the employees went to the hospital suffering from malaria. In 1913 the percentage was only 7.6 per cent.

A malarial district in one of the Southern states has recently undertaken an intensive warfare against malaria. As far as possible all persons were subjected to a blood examination for the disease. While not all persons with malaria constantly show the parasite in the blood, most of them do. One of the remarkable features in this experiment was that many persons who seemed to be in good health harbored malarial parasites. Obviously all persons with malarial organisms in the blood are possible carriers of the disease. Consequently they were treated with quinine and were guarded, as far as possible, while they had the parasites in the blood, from the bites of the anopheles mosquito. Furthermore, vigorous anti-mosquito measures were undertaken along the lines employed in the Canal Zone. Swamps and stagnant waters were drained; underbrush was cut away, and the remaining open water was oiled. Such a program is obviously expensive, but in the end will easily justify itself in the saving of money, health, and life.

The problem of malaria is not only a community problem, but also a personal one. The community can largely, but not entirely, exterminate the anopheles mosquito. But the individual also has a problem toward the mosquito. In the Tropics and in any malarial or anopheles district, the individual can usually protect himself by a proper mosquito net so applied as to keep out the mosquitoes. Communities and indi-

viduals, however, are only slowly applying the available knowledge to the prevention of malaria, but the examples of Havana and the Canal Zone have accomplished much for sanitary education.

The commercial value of the Tropics in the Western Hemisphere is great and it has been practically untouched on account of malaria and yellow fever. The future will probably see further demonstrations of the fact that business, often shortsighted in matters of health, is gradually recognizing the economic value of health. The same methods which made the Panama Canal possible and turned the Canal Zone from a pestilential hole into a health resort will make intensive business possible in the hitherto impossible Tropics.

Bubonic Plague

On account of its high mortality rate and the tremendous ravages which its epidemics have caused from time to time, the bubonic plague is rightfully one of the most dreaded of the communicable diseases and one most rigidly guarded against by health authorities. Plague has been known since the earliest times. The Roman world was twice devastated by the disease and about 542 A.D. Egypt had a violent epidemic which lasted for a considerable number of years. In 1347 plague, called "Black Death", ravaged Europe and some 25,000,000 people, about one-fourth of the population, lost their lives. Another outbreak occurred in London in 1665 which destroyed some 70,000 lives. This was the epidemic which inspired DeFoe's "Journal of the Plague Year." The latest great epidemic of plague started in Canton and Hong Kong, China, in 1894. In Canton, where the disease had never occurred before, it killed 180,000. In 1896 the disease reached Bombay and in all India since then there are said to

have been over 5,500,000 cases with a death rate of slightly over ninety per cent. The plague continued its travels and in 1899 reached New York and South America. The disease has been endemic in South America ever since. In 1900 the plague appeared in San Francisco and there were twenty-two deaths that year, twenty-five in 1901, and forty-one in 1902.

The plague is caused by a specific bacillus, the bacillus pestis. The disease is now known to be one peculiar to rats and apparently only secondarily and accidentally transferred to other animals, including man. The usual method of transferring the disease is through the flea. Certain fleas inhabit man or animals indifferently. Bubonic plague (glandular plague) is apparently always transmitted by fleas. In the course of bubonic plague, however, at least two other forms of plague appear in a small percentage of the cases, pneumonic and septicemic plague. Pneumonic plague may occur in epidemics like the one in Manchuria studied by Strong. In septicemic and bubonic plague the bacteria are sealed up, as it were, in the body and apparently do not appear in the secretions. In these forms of plague, therefore, man is only dangerous through the agency of the flea. In the pneumonic plague, on the contrary, the bacilli are coughed out in enormous numbers and the infection spreads from man to man through the air in droplets. So far as is known no one has ever recovered from pneumonic plague. The mortality of the common form of plague, on the other hand, varies from sixteen to ninety per cent, averaging in epidemics, not far from seventy-five per cent. One attack of the disease usually renders a person immune for life, so that there have been many attempts to secure a curative serum and a vaccine. Yersin's anti-plague serum has a mild curative property and a slight temporary protective action and is of little practical use. Haffkine's vaccine

is of considerable value as it affords moderate but by no means complete protection and reduces rather markedly the mortality of the disease in those vaccinated.

Plague prevention consists of warfare on rats and fleas in general and the prevention of the spread of plague among rats and from rats to other animals and man. Much of our knowledge concerning bubonic plague and measures for its prevention is derived from the admirable work of the United States Public Health Service in California, originally under Dr. Rupert Blue, now surgeon general of the public health service. This plague prevention work in California has cost millions of dollars but it has undoubtedly prevented terrible epidemics of the dread disease. In California the plague was transmitted from rats, presumably by fleas, to the ground squirrels. At the present time these squirrels show plague in a small percentage of cases, but plague does not exist in the city rats. Human plague has actually been traced to plague in ground squirrels transmitted by fleas so that it is necessary to prevent the re-introduction of plague into the city rats. Squirrel-free zones about cities are maintained; ground squirrels and rats are destroyed as far as possible, and houses and buildings are built rat proof. Finally, ships from the plague-infested Orient are rid of rats which might introduce plague. Similar measures have been very effective in Manila and in selected areas in the Orient. While plague continues to exist in many parts of the world, we now possess the adequate knowledge to make, in the future, any world-wide epidemic of plague or black death impossible.

Typhus Fever

The attention of the world has been recently attracted to typhus fever through the striking and devastating

epidemic in Serbia, but the disease has been known for a long time. Formerly it was much more prominent than typhoid fever is to-day. Typhus fever has been known under the names of "Jail Fever" and "Filth Fever." It is essentially a filth disease associated with the overcrowding of people, with great armies, during famines, and on ships in which the crew or passengers are huddled together for a long time. There were several epidemics of typhus in the last half of the sixteenth century, during the eighteenth century, and in the early part of the nineteenth century in various parts of Europe. During this period typhus was a constant source of terror in the jails and in the centers of population. In 1846 a virulent epidemic of typhus ravaged Ireland and England. The disease first appeared in America in New England in 1807. Its last appearances in epidemic form in this country were in New York 1881–82 and in 1892–93 and in Philadelphia in 1883. The disease prevails extensively in Mexico, and is always present in Persia, China, Hungary, and Turkey.

The causative organism of typhus fever is as yet undiscovered, and, consequently, there is frequently considerable difficulty in making an accurate diagnosis. It has recently been established, however, that the typhus fever of the Old World and the typhus fever of Mexico are identical. Furthermore, we have constantly with us here in the United States a mild form of typhus fever usually known as Brill's disease. The writer has reported nearly thirty cases which were treated in the Massachusetts General Hospital in the course of ten years.

The association of typhus fever with filthy living conditions was followed in due time by the discovery that the disease is transmitted from person to person by lice. The recent Serbian epidemic, as well as other previous epidemics, are associated with conditions

favoring the increase and spread of lice. Preventive measures are directed against the louse and the isolation of patients from lice. Cleanliness of the person and the extermination of lice in clothes and bedding prevent the spread of typhus fever.

Filariasis

Elephantiasis, while occasionally due to other causes, is usually the important symptom of a disease which is probably, but not certainly, transmitted by the mosquito. The disease is peculiar to the tropical and subtropical regions where it is very common. The direct cause is a thread-like animal parasite, filaria, which is communicated to the individual by mosquito bites. The usual prominent symptom is the permanent enormous swelling of one or both legs and, in the male, of the scrotum.

Dengue

Dengue is a common, but not fatal, short febrile disease of tropical and sub-tropical countries. The cause is unknown, but the disease is probably transferred by mosquitoes.

Sleeping Sickness

Sleeping sickness is largely a disease of tropical Africa, especially about the Congo River. It may run a course of years and derives its name from the principal symptoms. The disease is caused by an animal parasite, the trypanosoma, which is carried by the biting of the tsetse fly. The mortality of the sleeping sickness is apparently one hundred per cent and it has killed hundreds and hundreds of thousands of natives in Africa. The tsetse fly lives in the grass and bites

at night and the protection against it is the same as for malarial insects. The extermination of the tsetse fly in tropical Africa is at present impossible and most of the protection is afforded by individual precautions against all biting insects.

Diseases Caused by Ticks

The ticks transmit certain diseases. The best known of these diseases are Texas fever of cattle (chiefly interesting as being the first disease traced to ticks), Rocky Mountain spotted fever which occurs, as the name indicates, particularly in Montana, Idaho, and Wyoming, and relapsing fever, which seems to be carried by other biting insects as well as a peculiar African tick fever.

Leischmaniasis

Peculiar micro-organisms, known as Leischman-Donovan bodies, are the cause of a group of diseases not yet well defined. There is evidence to support the view that some members, at least, of this group, notably Kala-Azar or dum-dum fever of India, a common and highly fatal disease with anemia and large spleen, and a similar disease among children in the Greek islands are spread by the bites of fleas or bedbugs.

The rôle of insects in transmitting disease is a recent discovery, and probably the list of diseases so transmitted is not yet complete, although it is already formidable. Malaria, yellow fever, dengue, and filariasis are transmitted by mosquitoes. Sleeping sickness is transmitted by the tsetse fly; bubonic plague by the flea; typhus by the louse, and certain specific fevers by ticks. Then the fly with its filthy habits may spread various diseases, such as typhoid fever. All in all the

indictment against insects, especially the biting insects, is serious. It is because insects flourish in the Tropics that so many of the insect-borne diseases are tropical. Before the Tropics can be made healthy, some means must be found to eliminate or reduce the insect carriers of disease. But our knowledge gives us a guarantee that the future will see no more worldwide epidemics of yellow fever, typhus fever, or bubonic plague.

CHAPTER XVI

Diseases in Which the Method of Spread is Unknown

There are a number of diseases in which the channel of infection and the method of spread are entirely unknown. There seems to be no doubt that the diseases are communicable, but how the infection passes from person to person has not been solved. In these diseases we find illustrated the fact that ignorance and mystery are active sources of fear, for the two main diseases in this group — infantile paralysis and leprosy — have both been the cause of popular hysteria and of unreasoning panic. It is not remarkable, however, that people especially dread those things which spring up mysteriously and which cause devastation, but against which there seems to be not only no certain but also no logical protection.

Infantile Paralysis

Infantile paralysis (acute anterior poliomyelitis) is now regarded as a communicable disease, although the exact method of transfer has yet to be discovered. As the name indicates, sufferers from this disease develop paralysis, which, in a majority of cases — roughly sixty per cent — continues through life. About half of the remainder die and the rest recover completely. In some epidemics the mortality has run as high as twenty-five per cent, while in others only eight per cent died. The disease mainly attacks the young, the large

majority of the cases being under six years of age, while it is extremely rare in persons over thirty years of age. The main incidence of the disease is during warm weather and in localities with a wide range of climate. Until the epidemic of 1916 infantile paralysis had been rather more prevalent in towns and in country districts. No class of society is immune from attack.

Infantile paralysis has been known since the earliest Egyptian times, but in its modern aspect the disease had become of importance only very recently. The first great epidemic of infantile paralysis of modern times occurred in Norway and Sweden in 1905, some 2,000 cases being reported. In 1907 came the first great epidemic in the United States, 2,500 cases being reported about New York and about 2,900 cases in the country. In 1909, after 1908 with only 392 cases, there was another outbreak with 2,345 cases. By 1910 the disease had reached forty-three of the states. In that year there were 1,459 deaths from the disease in the registration area of the United States, with approximately 9,000 cases.

During the summer of 1916 there was an epidemic of infantile paralysis in New York with approximately 10,000 cases. The mortality rate was unusually high, over twenty-five per cent. On account of the rather striking effects of the disease and the inability to cure or to effect a stop to its spread, infantile paralysis created a panic in many localities. Regrettable as the situation was, it should be remembered that this plague caused only a fraction of the deaths which resulted during the same period from poor milk, deaths which were entirely preventable.

The ultra-microscopic virus which causes infantile paralysis has been discovered, but little else is known about the disease. The mode of transmission is probably some curious method of contact from person to

person, since only a small proportion of those in intimate contact with the cases contract the disease. We are also without an effective method of treatment, although injections of serum from patients who have recovered from the disease seem to have a slight beneficial effect.

The 1916 epidemic in the United States has brought out two important facts. In the first place examination of the spinal fluid obtained by spinal puncture showed that there are many cases of infantile paralysis which are never paralyzed. In other words paralysis is not a necessary symptom of the disease. These cases without paralysis had all the other clinical symptoms and could only be positively diagnosticated by the examination of the spinal fluid. The second important fact was the establishing of a more or less close association of many cases with previous cases. In this epidemic the hitherto unrecognized cases without paralysis often made the connection between cases. These findings confirmed the earlier studies in the Scandinavian countries, where the evidence pointed strongly to the transmission of the disease from person to person. Since the virus is present in the mucous membrane of the nose, suspicion is naturally directed towards the droplet method of infection. But as yet the precise method of transmission is undetermined. There is some evidence that there are healthy carriers. In addition there is some evidence, not substantiated in the 1916 epidemic, indicating that the disease may be transferred by a biting insect, the stable fly.

We have little positive knowledge upon which to base intelligent precautions against the spread of infantile paralysis. It is reasonable to take all the usual precautions which we employ in diseases transmitted in food and drink, by droplets and in the air, by contact, direct and indirect, and by insects. Carriers should be

guarded against. These precautions entail strict isolation which cannot fail to be effective. We must await more knowledge of the method of spread of the disease before we can hope to combat it with any marked degree of success.

Leprosy

Leprosy is a disease which has caused the greatest apprehension to all races and to all peoples since the beginnings of history. The cry of "Unclean, unclean!" is present in the earliest literature and the picture of the outcast ringing his bell to warn all passersby of his contaminating presence is equally familiar. These practices typify the horror and loathing with which leprosy and lepers have always been regarded. Probably the first records of the disease are found in the Egyptian papyri of 4260 B.C. The Bible, in the Book of Leviticus, gives a detailed description of the disease and suggests the measures of segregation which even at that date were used to control leprosy. In India and China, where, even to-day, there are the largest numbers of lepers, the first description appears about 700 B.C. In the Middle Ages leprosy was epidemic in Europe.

At the present time there are about 3,000,000 lepers in the world and few countries are free from the disease. China has about 2,000,000 lepers; India 200,000 and Japan 20,000. The United States, Hawaii, and the Philippine Islands all have cases. There are probably several thousand cases of leprosy in the United States, although, on account of the rarity of the disease, cases are not always recognized. Practically all cases of leprosy in this country were contracted elsewhere.

Leprosy is caused by a definite bacillus which closely resembles the tubercle bacillus. The mode of transmission is entirely unknown, but we are certain that

it is communicable, for people who have taken care of patients have contracted the diesase.

The repulsive character of the disease early drove communities to take drastic measures to prevent its spread. These measures consisted in the complete and rigorous isolation of lepers, so that all precautions were taken against all possible methods of transmitting the disease. Such measures were undertaken in the belief that leprosy was highly infectious. As a matter of fact there is abundant evidence that the disease ranks rather low as a communicable disease. The leper may give off millions of bacteria in coughing, yet cases of infection among doctors and nurses are extremely rare. Nevertheless the strict isolation, though perhaps unnecessarily cruel, is very effective against leprosy as against any other infectious disease. It is worthy of remark that, impelled by fear, the public at large has insisted on every known precaution and extreme isolation only in this disease which has a low infectiousness. Leprosy is essentially chronic and essentially fatal, though proven cures have occurred. Until we know the method by which the disease is spread, the stringent isolation, while perhaps unnecessary, may be wisely continued.

CHAPTER XVII

General Considerations in Communicable Diseases

It has become the fashion loudly to proclaim that all the communicable diseases are preventable. Theoretically this is true, but practically it is not. The prevention of disease depends on the characteristics of each disease. So the prevention of communicable disease does not permit of generalization.

Formerly it was argued that the person sick with a communicable disease represented the only source of danger. At first contagion or touching seemed to be the sole method of transferring disease. Then the air received its share of blame. Of course the infected person, directly or indirectly, is the sole source of most of the communicable diseases, but in some instances we have to guard against his excretions, which may be carried long distances, as in typhoid fever. Again, he may be well but able to transmit the disease, as in the case of the typhoid carrier. Then, too, insects may transmit disease. Finally, we have a few diseases traceable to the lower animals, as bovine tuberculosis, plague, anthrax, glanders, rabies, Malta fever, and tapeworm.

Adequate preventive measures vary with the disease. In some diseases there are special preventive measures only effective against the one disease. Smallpox is prevented by vaccination; typhoid fever by sanitary control of water and milk and vaccination; rabies by

muzzling laws, yellow fever by anti-mosquito regulations, plague by war on rats, and so on. The venereal diseases are preventable only by social changes. Tuberculosis is largely a social disease and is to be eliminated by social as well as by medical efforts. The individual can avoid venereal disease through his personal efforts, but his protection against typhoid fever comes from the community. The individual and the community working together can accomplish much, but there is needed not only education of the community but also the education of the individual.

Obviously it is impossible and probably undesirable that the individual be responsible for all the details of the precautionary and the preventive measures of all the communicable diseases. As we have shown, these measures actually vary in the case of each disease. In some diseases our knowledge is as yet so slight that we do not know the proper protective measures either for the individual or for the community. Consequently the control of communicable diseases in civilized countries is largely given over to the community or to the representatives of the community, who are, or should be, experts in such matters. Boards of health are intrusted by law with a varying amount of authority in regard to communicable diseases, but experience has shown that the legal authority of the boards of health is inoperative in actual practice, unless supported by public opinion. The fear of leprosy is so great that unusual and perhaps unnecessary isolation is enforced. Yet syphilis exacts its tremendous toll without isolation or even the formal recognition by the boards of health of the existence of such a disease. The education of the individual concerning the communicable diseases prevents disease not only in his individual actions but also in determining the activity of the health agencies. Intelligent public opinion

will not only support the wise actions of the health officials of the community, but will by the creation of proper machinery, the selection of competent persons (keeping matters of health out of politics), and the appropriation of sufficient funds, largely determine the activity of the health department.

It must be frankly admitted that the prevention of most communicable diseases is mainly a matter of money. It is entirely feasible to eradicate hookworm and malaria from the United States, but it would cost vast sums of money. Thus disease brings in not only the purely medical factor and the social factor, but the economic factor as well. In order that the individual, the taxpayer, and citizen, as well as the sufferer from communicable disease, may wisely decide many of these complicated problems involving medicine, economics, and sociology, he must have a reasonable understanding of the diseases themselves. Too much must not be expected of a board of health which is handicapped by the ignorance of the public. Medical knowledge, of course, is considerably in advance of the community application of this knowedge, but this is partly attributable to the rapid strides of medical science within the last thirty years. Boards of health endeavor to keep pace with medical knowledge, but they must also, unfortunately, keep in step with public opinion.

Naturally one finds varying activity of boards of health, but all such boards attempt in some way to control the spread of the communicable diseases. The following list of reportable diseases, published by the Massachusetts State Board of Health, is typical of the attitude of health boards in general. This list makes one definite and purposeful omission in that it does not include venereal diseases, the omission being due to so-called public prejudice. The second column

lists the presumable method of transmission of the diseases.

Actinomycosis	Contact
Anterior poliomyelitis (infantile paralysis)	?
Anthrax	Contact
Asiatic cholera	Ingestion
Cerebro-spinal-meningitis	Air borne (droplet)
Chicken pox	Air borne (droplet)
Diphtheria	Air borne (droplet)
Dog-bite (requiring anti-rabic treatment)	Contact
Dysentery	
a. Amebic	Ingestion
b. Bacillary	
German measles	Air borne (droplet)
Glanders	Contact and air borne (droplet)
Hookworm	Contact
Infectious disease of the eye	
a. Ophthalmia neonatorum	Contact
b. Suppurative conjunctivitis	Contact
c. Trachoma	
Leprosy	?
Malaria	Insect
Measles	Air borne (droplet)
Mumps	Air borne (droplet)
Pellagra	Probably metabolic and not communicable
Plague	Insect and air borne
Rabies	Contact
Scarlet fever	Air borne (droplet), also ingestion

Septic sore throat	Air borne (droplet), also ingestion
Smallpox	Air borne (droplet)
Tetanus	Contact
Trichiniasis	Ingestion
Tuberculosis (all forms)	Air borne, ingestion, rarely contact
Typhoid fever	Ingestion
Typhus fever	Insect
Whooping cough	Air borne (droplet)
Yellow fever	Insect

Results and Sequelæ of Communicable Diseases

The communicable diseases are more important than merely causing temporary illness or death, for many times their after effects are much more important than the actual disease. Such after effects are, roughly, two-fold: general and specific. It is well known that illness, especially when associated with fever, is weakening. A prolonged fever or a serious illness, in all probability, like hard and unusual use of a machine, causes a certain, but varying, amount of deterioration. The human machine automatically takes care of the wear and tear of everyday life. But this is by no means complete for we have old age which, in reality, begins at birth, or even before, to manifest itself. Old age and hardening of the arteries or arterio-sclerosis are practically synonymous. It is probable that the communicable diseases, particularly those with prolonged fevers or any other exhausting symptom, play an important rôle in inaugurating prematurely the manifestations of old age and arterio-sclerosis. The communicable diseases represent only one of the factors which determine premature age, for heredity, the general habits of life, and other poisons, all have their

share. One communicable disease, syphilis, notoriously hastens the aging process, but this action is probably largely a local effect on the heart and blood vessels.

Certain of the communicable diseases have specific effects in addition to the general effects. In tuberculosis, for example, a person who has had trouble with his lungs, if he gets well, will always have scars in his lungs. Most of the communicable diseases, however, do not tend to destroy the tissue so as to leave a scar, and the most careful examination after death will not show from what communicable diseases the person suffered. During typhoid fever there may be a mild infection of the gall bladder and this disturbance is the most common single cause of gallstones. Such gallstones may not develop or, at any rate, may not cause symptoms until many years after the typhoid fever.

But there are sequelæ to the communicable diseases, which are often apparently remote in time. Such sequelæ are particularly noticeable in damage to the heart and kidneys. Valvular disease of the heart, nearly always in people up to fifty and often in people over fifty, can be traced back to some infection, perhaps many years before and generally apparently trifling. The infection may be syphilis, but more probably it is caused by one of the group of diseases due to the micrococci. After an epidemic of tonsillitis, for example, a certain proportion of cases will have permanent damage to the heart. The germs get into the body, settle on a valve of the heart and cause a deformity of the valve. What happens after tonsillitis may happen after any other of the infectious diseases. It is easy to say that such diseases as tonsillitis and gonorrhea are trivial, but the victim of one of these diseases may be incapacitated from heart disease as a result of these ailments.

Diseases of the kidneys also follow certain of the communicable diseases. Kidney disease (Bright's disease), especially in young people, is particularly apt to follow scarlet fever.

Heart disease and Bright's disease are definitely on the increase and, together, are the cause of one out of every five deaths. There are, of course, various forms of such disease and they are often only the expression of aging and the wear and tear on the human body, but in middle life and in young adult life they are usually traceable to some infectious disease. The prevention of heart and kidney disease, therefore, means the prevention of communicable diseases. The toll of the communicable diseases is not found only in immediate mortality or immediate disability tables, but also in the deaths and disabilities of their sequelæ.

It will be noted that the discussion of the communicable diseases has not included all the diseases of bacterial origin. In general, inflammation is caused by bacteria. These bacteria must be derived from somewhere, so, in a sense, all bacterial inflammations are communicable. The inflammatory damage of the heart and kidneys, bacterial in origin, begins with some infectious disease and often continues in the heart and kidney long after the infectious disease has apparently disappeared. In a similar fashion most structures of the body are subject to inflammation. The source of the bacteria which causes the inflammation may be, and often is, obscure. We have in our intestinal tract, for example, many bacteria that are harmless so long as they do not leave the tract. But under special conditions of the intestines, as an injury, or of diet, or of the bacteria themselves, the intestinal tract may furnish to any part of the body the bacteria which may inflame any structure.

Appendicitis is caused by bacterial action. Our present knowledge does not permit us to apportion the various factors which bring about this disease. A variety of bacteria may be the cause, but just what factor or factors allow the bacteria to inflame the appendix is at present unknown. It seems reasonable to assume that a proper diet and a normally acting intestinal tract do much to prevent appendicitis, although we must confess that the disease is in no way preventable.

Another source which furnishes bacteria for the inflammation of various structures is the whole region of the nose, mouth, and throat. We are beginning to appreciate that bacteria about diseased teeth, damaged tonsils, and abnormal sinuses frequently invade distant parts of the body and cause inflammation of these structures. This seems to be especially true of joints. The prevention means the correction of abnormalities which favor the entrance and development of the bacteria in the original focus. In a similar way any inflammatory focus in the body may serve as the source from which bacterial inflammation of a distant organ may arise.

Certain forms of so-called " rheumatism " illustrate how a variety of bacteria may inflame one of the structures of the body, namely, the joints. " Rheumatism " is a difficult disease to define. From a medical standpoint rheumatism may be divided into two large groups classified according to the causes. One type is due to bacteria or its poisons, the so-called infectious form of rheumatism. Another type is due to chemical changes in the body, metabolic rheumatism. The latter form of the disease is familiar because it frequently occurs in old people who have deposits around their joints. The usual form of rheumatism is that associated with bacteria, which is found more fre-

quently and more severely in the changeable climates of the Temperate zone. The disease has been known as long as we have any records in the form of literature.

Rheumatic fever is a fairly definite disease of varying severity. Definite germs have been isolated and described, which have been associated with particular epidemics of rheumatic fever. There is a good deal of evidence to show that there are waves of rheumatic fever and in addition the character of the disease alters in different outbreaks. Closely allied with epidemic occurrences is the possibility of spread by contagion and some remarkable examples of this have been recorded. The classical form of rheumatic fever is associated with a definite micrococcus.

Rheumatism, or, better, arthritis, frequently follows tonsillitis. In this case the micro-organisms which cause the tonsillitis secure entrance to the blood and infect the joints. At the same time the bacteria may go to the valves of the heart. Twenty-five per cent of the people who have rheumatic fever or an inflammation of more than one joint with fever eventually manifest some damage to the heart valves. The same condition of affairs may follow an attack of gonorrhea. Scarlet fever, pneumonia, and infected teeth and tonsils may also cause rheumatism. In every case it is an evidence that the disease is no longer local, but that the germs have secured an entrance into the blood and attacked the joints of the patients. It should be remembered that rheumatism, by and large, is an evidence that the defenses of the body have broken down and that the disease is no longer local.

The seriousness of the acute form of rheumatism is not at all dependent on the temporary involvement of the joints. It derives its serious aspect from the fact that it represents a general infection and the liability to heart disease. All these conditions must have a

point of entrance. The particular point of entrance for rheumatic fever is usually the nose and throat, particularly the tonsils. If it were not for diseased tonsils, the cases of rheumatic fever and the subsequent devastation from heart trouble and kidney trouble would probably be few.

CHAPTER XVIII

CANCER

CANCER presents one of the most serious problems of disease, for not only does it cause a considerable proportion of the deaths — from five to ten per cent — but there seems to be no doubt that the disease is increasing rapidly. In 1915 in the registration area of the United States there were 54,584 deaths from cancer and other malignant tumors, and, if the whole country had been included, the figures would probably show about 80,000 deaths from this disease. But the rapid increase of the death rate from cancer is the most alarming feature. The death rate has risen from sixty-three per 100,000 in 1900 to 81.1 in 1915. In Massachusetts in 1871 the recorded cancer death rate was 36.9 per 100,000 of population; in 1881, 52.3; in 1891, 60.9; in 1901, 73.1, and in 1911, 92.6. Statistics seem to prove that throughout the world cancer annually kills some 500,000 people and that the disease is markedly on the increase in all civilized countries.

In spite of the great efforts which have been made in the study of cancer, we know comparatively little about it. We actually have no idea of the cause of cancer, and we have, therefore, little idea of how to check the growth of its mortality. Many theories have been set forth as to the cause. The available evidence seems to indicate that cancer and tumor are not caused by bacteria. There is some evidence which tends to show that errors in nutrition may

be a contributory cause as may be various irritations. It is not believed that the disease is hereditary. Cancer is probably a disease associated with the general tendency of retrogression in the body; that it is a part and parcel of old age, for cancer is essentially and mainly a disease of late adult life and old age.

Cancer occurs in all walks of life and in all countries. It causes a slightly larger death rate among females than among males. Savage tribes seem to be somewhat immune and so cancer has been attributed to the evils of civilization. But this is simply a matter of opinion, for, of course, we have no reliable statistics on this matter. Malignant tumors, often closely resembling human tumors, occur in many of the lower animals. Spontaneous tumors of mice are rather common.

There is no medical treatment for cancer. The simplest and best thing to do is to have the growth removed by the knife, although the X-ray and radium may also be used to accomplish the same end. Probably the combination of the knife and the subsequent use of the X-ray is the best method. The statement often advertised by unscrupulous quacks that all cancers can be removed by the X-ray and radium is a cruel untruth, for they only destroy cancers which are situated favorably. If the growth is a large one, the X-ray and radium would have to be used to such an extent as to destroy the surrounding tissues and life.

Education of the public as to the dangers of cancer and the best methods to pursue in its eradication seems to be the most hopeful method of decreasing the increasing mortality from the disease. It should be insisted that cancer, if removed early, is a curable disease, but, if neglected, it is invariably fatal. All chronic irritations should be avoided and, if any wart

or sore occurs spontaneously, as on the lip, after the age of forty-five, it is ordinarily cancer.

The following directions to the public, issued by an English city, are so excellent as to be worthy of imitation elsewhere:

Instructions on Prevention of Cancer

1. Cancer, in its early and curable stage, gives rise to no pain or symptom of ill-health whatever.

2. Nevertheless, in its commonest situations, the signs of it in its early stage are conspicuously manifest.

3. In case of any swelling occurring in the breast of a woman after forty years of age, a medical man should at once be consulted. A large proportion of such swellings are cancer.

4. Any bleeding, however trivial, occurring after the change of life means almost invariably cancer, and cancer which is then curable. If neglected till pain occurs, it means cancer which is almost incurable.

5. Any irregular bleeding occurring at the change of life should invariably be submitted to a doctor's investigation. It is not the natural method of the onset of the change of life, and in a large number of cases means commencing cancer.

6. Any wart or sore occurring spontaneously on the lower lip in a man over 45 years of age is almost certainly cancer. If removed at once the cure is certain, if neglected the result is inevitably fatal.

7. Any sore or swelling occurring on the tongue or inside of the mouth in a man after 45 years of age should be submitted to investigation without a moment's delay, and the decision at once arrived at by an expert microscopical examination whether it is cancer or not. A very large proportion of such sores or swellings occurring at this time of life are cancer, and

if neglected for only a few weeks the result is almost inevitably fatal. If removed at once the prospect of cure is good.

8. Any bleeding occurring from the bowel after 45 years of age, commonly supposed by the public to be "piles", should be submitted to investigation at once. A large proportion of such cases are cancer, which at this stage is perfectly curable.

9. When warts, moles, or other growths on the skin are exposed to constant irritation, they should be immediately removed. A large number of them, if neglected, terminate in cancer.

10. Avoid irritation of the tongue and cheeks by broken jagged teeth, and of the lower lip by clay pipes. Many of these irritations, if neglected, terminate in cancer.

11. Although there is no evidence that cancer is communicable under ordinary circumstances it is desirable that rooms occupied by a person suffering from cancer should be cleaned and disinfected from time to time.

CHAPTER XIX

Milk

Milk is the most liable of all the foods to convey disease, for several reasons. Milk is an excellent medium for the growth of bacteria. It is the most difficult of the food-stuffs to obtain, handle, and deliver in a clean, fresh, and satisfactory condition. Milk decomposes rapidly, and, finally, it is the only important article of diet which is consumed in the raw state. As the amount of milk consumed as food is enormous, the problem of safeguarding the supply is one of the utmost importance.

Milk itself is not dangerous. Even the presence of bacteria does not make it dangerous. It is the presence of disease-causing bacteria in the milk which is dangerous. Bacteria-free milk is a practical impossibility. The health authorities merely specify the maximum number of bacteria that milk may contain. In Massachusetts one cc. of milk may not contain more than 500,000 bacteria, while New York permits 1,000,000 per cc. It follows that these requirements based on bacterial counts are founded on the doctrine of chances. When there are few bacteria in milk, there is much less likelihood of some of these bacteria being the disease-bearing types than when there are many bacteria which are probably introduced by gross contamination. This theory works well in practice.

It is evident that bacteria can get into milk from two sources, one from the milk-giving animal; the other

from outside. The most important bacterium which comes from the cow is the tubercle bacillus. The importance of bovine tubercle bacilli in the causation of certain forms of tuberculosis has already been suggested. The presence of such bacilli in milk is extremely common and it is estimated that ten per cent of uninspected milk contains tubercle bacilli. As a rule tubercle bacilli are only present in the milk when there is tuberculous disease of the udder, a diseased condition of the cow which can usually be detected by superficial examination of those parts. The tuberculin test, while not infallible, is of great value in revealing any tuberculosis in the cow. Any cow which shows positive signs of tuberculosis should be eliminated from the herd, for the danger from such a cow far outweighs any economic considerations. Such a cow will spread tuberculosis among the other cows and eventually from some of the cows tubercle bacilli will be present in the milk.

Cows may also be afflicted with inflammation of the udder, the most common being an inflammation caused by the streptococcus, the same organism which causes septic sore throat. Epidemics of septic sore throat have been traced to milk from a cow with inflammation of the udder, although the majority of milk-borne epidemics of septic sore throat can be traced to milk contaminated from human sources. Diseases of the udder can be easily detected by inspection and can be controlled by examination of the milk itself. The presence of pus-cells in the milk, together with a high bacterial count, indicates udder inflammation of the cow.

Mention should be made of the transfer of Malta fever to human beings by drinking milk from goats with the same disease, and also of the transfer of milk sickness, " slows " or " trembles", and of foot and mouth

disease by milk from cows with these diseases. All these diseases are preventable by the competent inspection of dairy herds.

The milk of cows and, likewise, the milk of human beings is affected by the food and so may affect those taking the milk. Reasonable care should be taken where cows graze. The cows which furnish the highest grade of milk for infants are not permitted to graze at large but are wisely fed on carefully selected fodder.

Despite these possible dangers arising from the animal giving the milk, experience has shown that most of the danger comes after the milk has left the animal. There is little danger from milk taken on the so-called "short haul." Thus the breast-fed baby and the suckling calf usually flourish, provided the mother is healthy. But most of our milk is consumed after a long haul. The danger of the contamination of milk is obviously proportional to the length of the haul, if one includes the length of time and the amount of handling as well as the distance. Milk may be contaminated at any point from the cow to the consumer.

Dirt from the cow may fall into the milk; the hands of the milker may be none too clean; the pail may be dirty, and the milk may be taken in an uncovered vessel on a long and circuitous route through a dirty barnyard. The barnyard flavor and smell of milk so highly regarded by some people is due to barnyard dirt in the milk. From the barn milk may go on a long journey, perhaps with many changes of containers, where it is exposed to air and dirt. As the milk is sold, it may be exposed again and, finally, it may be contaminated during serving. Thus the possibility of contamination is enormous. The milk will inevitably contain some bacteria. But while milk furnishes such an excellent medium for growth of bacteria, the growth

can be checked by keeping it cool at all times. This means a temperature of 50° F., or lower, for above this temperature bacteria will grow rapidly. The souring of milk depends on the activity of bacteria, but the usual bacteria which sour milk are harmless and their rapid growth is prevented by cold just as the growth of the harmful bacteria which may or may not be present in the milk.

All the diseases which are transmitted by water may be transmitted by milk and many others in addition. Epidemics of typhoid fever and cholera have been traced to milk. Diphtheria and scarlet fever, although usually air-borne, are sometimes transmitted by milk. Within the past few years a number of epidemics of septic sore throat have been transmitted by milk. While this may have its origin in the inflammation of the cow's udder, it is more often caused by an infection from the person who handles the milk. Milk-borne epidemics are usually of sudden onset and affect all susceptible persons who drink the milk. Milk is frequently infected on a small scale. Thus one can trace to milk many of the intestinal disturbances of infancy and childhood. Milk is almost the exclusive food of infants and infant mortality is largely dependent on the milk supply. It is well known that intestinal disturbances of childhood (cholera infantum, summer diarrhea, etc.) are much more common in summer when it is difficult to keep milk cold and thus prevent the growth of bacteria.

In most of the warm European countries milk is only used as food for infants, due to the fact that the people use little ice and so have difficulty in keeping the milk. Their experiences with diseases from milk have caused them to restrict the use of milk for food to infants and to immediate consumption. Milk is used in the United States as a food for adults far more

than in any other country of the same climate and density of population.

Since it is often impossible to classify milk as good or bad without examinations which are not finished until after the milk is consumed, another classification is widely used.

Certified milk means an excellent milk which is produced under the very best of conditions. It means that all reasonable precautions against contamination have been taken all along the line of production and distribution. However, these precautions are only those which are demanded by common sense. Instead of having a dirty barn, it is necessary to have a clean barn; the cows must be kept clean and the udders washed carefully. The cows are frequently inspected and tuberculin tested. Then the man who milks the cow must have clean hands and clean clothes and cleanly habits. The milk is taken into pails which have been not merely washed but boiled. The milk is then kept in sterile conditions at a temperature under 50° F. If all these precautions are taken, milk may be produced which contains less than 10,000 bacteria per cc. Of course it is not entirely the actual number of bacteria which concerns us, but the type. This milk is naturally expensive to produce and is used for babies and in hospitals.

The second form of milk is inspected milk. This should contain not more than 100,000 bacteria per cc. Inspected milk means that the cows are healthy and have been reasonably inspected, that the milk is produced under reasonably clean conditions, and that reasonable precautions have been taken to keep the milk clean and cold from the cow to the consumer. All milk should be inspected.

The third form is market milk. This grade of milk does not come from inspected sources and nobody

knows the condition of the cattle or the barns in which it is produced. Most of the milk which is sold in the large cities may be so classified. The one check which we have on such milk is the requirement as to the number of bacteria. All milk of this grade should be pasteurized.

Pasteurization of milk consists in heating it to such a temperature that it will destroy most forms of bacterial life (60° C. or 140° F.). This amount of heat continued from twenty minutes to half an hour will kill all the pathogenic bacteria but not spores. Boiling milk is even more effective but it affects the taste and probably the food value to some extent, while pasteurization does not.

Home pasteurization is more difficult than it seems at first sight, especially on a small scale. On the other hand, pasteurization on a large commercial scale is relatively simple. It is also desirable that pasteurization should take place when there is to be as little subsequent handling of the milk as possible. Pasteurization of milk is recommended merely as a reasonable and harmless method of safeguarding milk of doubtful quality.

Preservation of Milk. Numerous attempts to preserve milk have been made, but, at the present time, no completely satisfactory product has appeared. Dried or evaporated milk seems to be promising, but in all these substitutes it must be remembered that no substitute can ever be any better than the milk from which it is made. Children fed on prepared products rarely thrive, presumably due to the loss of vitamins in the preparation. Nevertheless honestly-made condensed, evaporated, and other forms of preserved milk may be suitable for a portion of an adult's diet.

Such preservatives as borax, formalin, and the like are now practically excluded by law. Not only are

many of these substances harmful in themselves, but they also usually cause harmful combinations with milk. If milk is obtained under favorable conditions and kept cold at a temperature which inhibits the growth of bacteria, the milk will keep for a number of days. Ocean liners are supplied with such milk which lasts throughout a voyage of ordinary length.

Sour milk, provided that it is soured by one of the non-pathogenic milk-souring group of bacteria, is not at all harmful. During recent years sour milk and buttermilk have been generally recommended by physicians. The enthusiasm for these products has been carried so far that tablets of lactic acid bacilli have been prepared for consumption after meals. All that these tablets contain are millions of bacteria pressed into a tablet and it is supposed that these bacteria cause some beneficial change in the intestinal tract. There is no question that lactic acid bacilli have a laxative effect, but they have no wonderful or extraordinary power.

Adulteration of Milk. Adulteration of milk means the addition of certain substances which may or may not be harmful. The substances usually added are water, preservatives, or some white substance intended to convey the impression of richness. Before adulteration, the milk is generally deprived of its cream, or skimmed, so that the adulteration is more a question of honesty than of health. Adulteration is, as a rule, easily detected by examination, for the law requires a certain amount of solids and of butter fat.

In the effort to have better milk there has always been more or less of a quarrel with the farmers. The latter tend to assert that they know how to produce milk and resent interference. In addition, many times, the farmers have been rather badly treated by the middlemen. On the other hand, it is true that

some farmers, who produce milk for the distant impersonal consumer, may not exercise the care of cows, hands, barns, and cans, which is necessary for the safe consumption of milk many hours later, miles away. Unsafe milk is not attributable to the farmers any more than to any other handler from the cow to the consumer. But in order to get safe milk it is necessary to be certain of the source of the milk by competent inspection of the dairy herds. There must be assurance of the cleanliness of all the conditions of producing, transportation, selling, and serving of milk by adequate inspection.

A New England city has recently suffered from an epidemic of typhoid fever which was traced to the milk from a farmer who " took no stock in pasteurization." His inability to appreciate the fundamentals of properly producing milk nearly cost him his life — he contracted the disease himself — and did cause disease to a considerable number of people.

In addition to the inspection of the source and the methods of handling milk, all milk should be subjected to periodic examination at times of consumption. This examination, which is easily carried out by an adequate laboratory, will serve to check up the inspection. Examination will readily disclose any faults. Lastly, unless milk after inspection shows constantly a low bacterial count under 50,000, pasteurization is probably desirable.

Clean, safe milk is more expensive to produce than doubtful milk. For example, milk from diseased cows must not be used and represents a loss. It means time, labor, and some equipment to sterilize cans and other containers of milk, rather than to trust that the other fellow has washed them. The transportation of milk under proper conditions means rapid travel and ice. The substitution of separate milk cans and

bottles, which avoids much handling, is more expensive than large cans and the old dip-tank with the measure, all of which were exposed to contamination and usually needed washing. Cleanliness, perhaps, costs more in terms of intelligence than in terms of money, but clean, safe milk means a saving of doctors' bills to the family and of loss to the community.

Everything which has been said about milk applies as well to cream and butter, for they are definitely milk products and carry the same risks as milk itself. In point of fact the cream contains more bacteria than the whole milk. More samples of butter contain tubercle bacilli than do milk.

Milk and Infant Mortality. Infants — children under one year — are largely dependent on milk and the question of pure milk is, therefore, closely related to that of infant mortality. The infant mortality represents about one-fifth of all the deaths of any nation, an enormous death rate, larger than that from any single disease. We can gauge, fairly accurately, the intelligence and prosperity of a people by its rate of infant mortality. In poor families the infant mortality is large. In the more well-to-do families there are not so many children and such families are more successful in "raising the children."

Within the last few years there has been a tremendous interest in infant mortality and the statistics on this matter are available. Chile has a general average death rate of 31½ per thousand of population, but the infant mortality for ten years has averaged 330 per thousand births. The infant mortality in Australia, in contrast, is around seventy per thousand. Scotland averages 109, England 101, Ireland 72, and Norway and Sweden from 76 to 85 per thousand births. It is surprising to find that the usually efficient Prussia has

the high infant mortality of 164 per thousand, while the average mortality of infants in the United States is about 140.

There are three great causes of infant mortality: immaturity; the respiratory diseases — diseases of the lungs, such as pneumonia, and the digestive diseases. The pneumonia may, however, be only terminal, — that is, a poorly nourished child contracts pneumonia more easily and more easily succumbs to the disease. The most important cause of infant mortality, however, is the digestive diseases.

Infants depend on milk for food, and hence for their growth, their well being, and their resistance to disease. Statistics show that the bottle-fed baby has a much smaller chance of survival than the breast-fed baby. This is particularly true in the summer, when the difficulty of keeping milk cold and of preventing bacterial growth is inevitably associated with digestive disturbances in infants. The breast-fed baby secures his milk without the attendant dangers which a bottle-fed baby must run.

A brave attempt is being made to combat infant mortality, mainly by insisting on the purity of the milk supply, but there are a number of other factors which enter into this problem. Many mothers have to work and this means that the child gets insufficient care and that the mother is unable to nurse her child. Then, too, there comes the problem of the proper nourishment of the mother. If she is underfed, as well as overworked, the mother cannot produce either the proper kind or a sufficient quantity of milk for the child. Poverty, ignorance, and low standards of living are the fundamental causes of an excessive infant mortality. A valuable experiment has been instituted in establishing milk stations in large cities, where milk of known purity is sold. These stations

are of the greatest importance for in no large city is the milk situation treated adequately.

Many cities have seen the establishment of prenatal clinics. The object of such institutions is to assure the child of as good a start in life as possible and to educate the prospective mother concerning the management of infants. Such movements are associated with proposed legislation concerning the employment of women during and just after pregnancy. Many of the factors concerned in the causation of infant mortality are definitely social and economic and the remedies are to be found in a readjustment of our present social and economic systems. But the factor of milk, probably the most important, directly or indirectly, can be easily remedied by adherence to the considerations which have been presented in this chapter.

CHAPTER XX

Water

Water is an ever-present and indispensable factor in human life. Water makes up about seventy per cent of the human body and, in addition, is a considerable element in all foods. Then the average person drinks more or less water, and even infants whether bottle- or breast-fed usually take some water as such. The human animal will die if deprived of water for a few days, and, furthermore, he demands water for the proper cleansing of his body, his clothing, and his utensils. In addition, the water-carriage system of sewage depends on the use of enormous amounts of water, as do certain industries, fire service, street washings, and similar uses. All these activities make the total amount of water demanded by our modern standards of life and health so enormous as to be beyond the comprehension of our ancestors. Formerly a gallon of water per person a day sufficed for purposes of drinking and washing, but to-day the average daily amount of water used for domestic purposes is usually estimated at seventeen gallons per person. In cities, the average daily consumption per person may be over 200 gallons.

This enormous consumption of water has everywhere led to the installation of public water systems, a service which, obviously, affects for good or ill the health of the great majority of people. Since the health of man is mainly affected, as far as water is concerned,

by the water he drinks, it would seem practicable to have two systems of water supply, one of certain purity for drinking, and the other for all general purposes, which may or may not be pure. This double water system is used in certain European cities, but it has never found favor in the United States. The objections are obvious. An impure water in a household would always be a menace. While suitable for sewage-carrying, impure water could never be used in connection with eating utensils. Carelessness, ignorance, or confusion would at some time be inevitable and would always court disaster. It is within the range of probability that new methods of water treatment or even the increasing consumption of water may result in the more general adoption of some modified plan of double water systems. In general, the water problem is in itself a special field, a field for the coöperative activity of the engineer, the chemist, and the public health physician.

Water and Disease. Diseases in which the causative agent gains an entrance to the body through the mouth and digestive tract are largely due to impure water. The rôle of water in the transmission of typhoid fever, cholera, and dysentery has already been pointed out. The water problem is by no means new, but the realization of the importance of water in disease is comparatively recent. Nor is the problem of water restricted to large gatherings of people, as in cities. Records show that typhoid fever was never rare in older days on the more or less isolated farm.

The problem of water is directly connected with that of human sewage. In general terms water causes disease because it contains disease-causing bacteria derived from the fecal excretions of a diseased human being. Obviously not all water polluted with sewage will cause disease, but always, eventually, the sewage

will contain disease-bearing bacteria and water containing such sewage will produce disease. Theoretically, if all sewage was disposed of properly, the water problem would not exist. Practically, it is much more effective and much more economical to purify water than to be certain of sewage disposal. As Hazen has pointed out, one dollar invested in water purification is as effective as ten dollars devoted to sewage disposal.

The purity of water depends almost solely on the presence of pathogenic bacteria. A clear sparkling water may be impure, while a turbid water with a distinct taste may be pure. Pure water in the strictest sense is a product of the chemical laboratory. Water is an excellent solvent and always contains a considerable amount of dissolved and suspended substances. The color, turbidity, taste, and odor of water are all due to these dissolved or suspended substances. With the exception of lead poisoning, it is uncertain that these substances in water, if not forms of bacterial or minute animal life, cause any disease, and, in fact, the evidence is to the contrary. Indirectly, a water disagreeable in appearance, taste, or odor may do harm if it leads to insufficient water drinking. Likewise, water may contain substances which irritate the intestinal tracts of sensitive individuals and thus cause diarrhea, or a change of water may be associated with constipation from the absence of the usual stimulating substances. But in general a change in diet and in the conditions of life is usually responsible for the intestinal disorders associated with a change in residence, although the change in water is commonly held to be at fault. There is no evidence that the formation of stones in the body, such as gallstones, kidney stones, or stones in the bladder, has any relation to the composition of the water.

There is, however, some evidence that goitre (enlargement of the thyroid gland) is associated in some mysterious way with water. In the Swiss Alps and around the Great Lakes goitre is common. The case against some constituent of the water in these localities as the direct cause of goitre is not proven as yet.

In the case of lead poisoning the proof is absolute. Natural waters do not contain lead, and lead in water is always derived from lead pipes or lead materials in water containers and the like. There are various conditions which favor the extraction of lead from the pipe or container. Naturally stagnant water, for example, will absorb more lead than running water. Cases of lead poisoning have been traced to lead pipes, lead-lined cisterns, lead-lined soda fountains, and lead cooking utensils. The symptoms of lead poisoning from water are often obscure, but death or permanent disability may result. It is obviously unjustifiable to use lead in pipes, cisterns, and utensils which convey water for domestic service, and any water which is suspected of containing lead should be analyzed.

Clear water and soft water are desirable and convenient, but they have little relation to health other than that they favor copious water drinking and washing with soap and water, both of which are conducive to health. It is always mechanically possible to clarify water, but the community must justify clarification and softening on the grounds of esthetic convenience and economy (to a certain extent in the use of soap), but not on any consideration of health.

Sources of Water. The sources of water are usually classified as three, although the sources overlap: rain water, ground water, and surface water.

Rain water is really distilled water and is pure, although it may be contaminated by the vessels in which it is caught or preserved and by handling. Un-

less screened, rain water may serve as a breeding place for mosquitoes. Little rain water, as such, is used for drinking purposes.

Ground water or subsoil water is from springs and wells of all sorts. This water, as well as that from artesian wells, is used for drinking by individuals and small communities. Since the soil acts as a filter, ground water is, as a rule, pure and it is polluted only by gross and near-by sewage disposal.

The pollution of a well depends on several factors. In the first place the soil is important. A sandy soil acts as an admirable filter and, unless overcharged, will prevent bacterial pollution beyond a distance of from twenty-five to fifty feet. But in sandy or rocky soils there is always danger that the pollution may flow along crevices. The character of the sewage is also of importance. The old-fashioned privy, properly screened from flies and properly treated by the burial of human excrement, enables a suitable soil to dispose of the pollution and does not permit a distribution over an area of more than a few yards. On the other hand, the open cesspool into which water waste and excrement run requires for safety a considerable area for the filtration of pathogenic bacteria. In sandy soils the distance may safely be as low as twenty-five feet, but that necessitates the absence of crevices in the soil and no overflow.

Surface water comes from the lakes and rivers and its purity depends on pollution with sewage. With the enormous increase in the use of water for all purposes and the increase in the population, especially in limited areas, surface water is used more and more. There are a few public water supplies which come from deep wells, but in most instances surface water is used. With the increased use of surface water the danger of pollution has also increased through the water carriage

system of sewage disposal and the increased population, as well as the difficulty in safe-guarding a much larger supply of water. Most surface waters require some form of purification, as is instanced by the experience of the cities on the Great Lakes. Few cities can so control their water supply that it requires no treatment.

Methods of Water Purification. The artificial purification of water depends largely on the same principles by which water is naturally purified. The essential is the elimination of pathogenic bacteria. The artificial purification of water is less than a hundred years old, and in the United States the movement for such purification is even more recent, dating back, for the most part, to the noteworthy investigations of the progressive Massachusetts State Board of Health.

Water is purified naturally by storage. Pathogenic bacteria tend to die out in time and all suspended matter sinks to the bottom. Sunlight and the contained oxygen in water, the fall and spring turn-over of the water, are all important factors in making water both pure and clean. Some precaution is necessary that the water of the surface is not driven directly by a breeze from the inlet to the outlet without storage. New York and Boston depend upon storage of water in artificial reservoirs and in natural lakes and ponds for the purification of their water supply. The effectiveness of this method is shown by the freedom of these cities from water-borne diseases. It is obviously the case that the shores of the reservoir, either natural or artificial, should be protected from pollution. Experience has shown, however, that it is not necessary to exclude human habitations from the shores of such reservoirs, although frequent and competent inspection is necessary. The storage of water is sometimes used as an adjunct to other methods of purification.

The slow sand filter is a second method of water purification. Many of the European cities and some American cities — Lawrence, Mass., Washington, D. C., and Philadelphia — make use of beds of sand spread over gravel in water-tight basins. The sand layer must be removed and cleaned at intervals. If there is much fine, suspended material — as in many muddy American rivers, — the sand filter becomes clogged and inoperative.

The rapid sand filter is largely an American development for water purification. In this method, the water is first treated by some coagulant, such as sulphate of aluminum or iron, and then the water can be rapidly passed through a sand filter. This method is cheaper in construction but more expensive in operation than the slow sand filtration method.

While all the foregoing methods depend on the elimination, by some means or other, of the bacteria, there are a few methods of water purification which aim directly to kill the bacteria. Probably of first importance to the individual is the application of the well-known principle that heat kills bacteria. This is not feasible on a large scale, but the individual can be sure of pure water by boiling. This will probably always be the method of choice among campers and among troops on the march, away from a water supply of proven purity. It is not necessary to bring the water to a boiling point, since the heat of pasteurization (approximately 140° F.), continued for twenty to thirty minutes, is sufficient. On the other hand, thermometers are not always available and there is no objection to boiling the water. The day's water supply for a camp can be easily secured in a few minutes and placed aside for cooling. The usual precautions are, of course, necessary in the handling and in the use of clean receptacles. The flat taste of boiled water, so

objectionable to some persons, can be largely obviated by vigorous shaking.

Ozone and violet rays will sterilize water, but their cost has so far prevented their use on a large scale.

Calcium hypochlorite (chloride of lime or bleaching powder) is widely and efficiently used to purify water. Only five to fifteen pounds of this substance are necessary to treat a million gallons of water. The cost is one-tenth that of filtration despite the recent increase in cost. The action depends on the strong oxidizing power of the hypochlorous acid which is formed on the addition of hypochlorite of calcium to water.

Chlorin is the most recent substance used for the purification of water and its use developed out of that of bleaching powder. Chlorin is largely used as liquefied chlorin gas (" liquid chlorin "). This purifying agent has been used with great effectiveness in small water supplies during the European War. The use of both the bleaching powder and chlorin may generate unpleasant tastes and odors, especially during cold weather. Care must be taken against overdosing the water. Both chlorin and bleaching powder are cheap, harmless, and easy and rapid of use. Cleveland, Milwaukee, and other cities use the hypochlorite method with satisfactory results.

Copper sulphate, in small quantities, is remarkably effective in destroying most of the algæ and some of the micro-organisms in water. In the amounts used copper sulphate is not uniformly successful in ridding drinking water of living pathogenic bacteria.

Impressed by the long list of water-borne epidemics, particularly of typhoid fever, over fifty per cent of the total population of the United States and eighty per cent of the population of cities over 10,000 are now supplied with surface water artificially purified in some way or with good water of known purity. Chicago

and Milwaukee had to suffer from epidemics of typhoid fever from their lake water supply; Lawrence and Philadelphia from epidemics from their river water supplies, and numberless towns and cities from epidemics from smaller water supplies before the importance of water purification was really appreciated. It is both probable and desirable that artificial purification of water will increase. The method of purification to be used is largely a question of location and of cost, and often a combination of methods is best. There seems to be a distinct tendency toward the use of germicides, not only on account of their cheapness, but also on account of the increased pollution of surface water and the overburdening of filtration plants.

The responsibility of the individual on the question of pure water is clear. The inspection of the water supply will tell him of the probability of the pollution of the water and examination will reveal whether the water is or is not polluted. A single examination under unusually favorable circumstances will not suffice. Polluted water always denotes a possible, although not a positive, danger. The presence of colon bacilli (the common bacterium of the intestine) always indicates that water is polluted with human excreta, though that pollution may not contain disease-causing bacteria, and the water may be extremely palatable or sparkling. Under the circumstances of the evidence of polluted water, the individual can always protect himself by boiling the water. As a member of the community it is incumbent on the individual to employ his best efforts to secure an effective artificial purification to this polluted water, since pollution will eventually lead to disease. In any event, artificial purification, as natural purification of water, must be checked up by inspection and examination.

Bottled Water. Many people, especially in traveling, drink bottled waters on the theory that they are safe. Most bottled waters come from springs or wells, in other words from ground water, which, under ordinary precautions, is usually pure. Water which has been bottled for any length of time may be compared to stored water in which the bacteria always tend to die out. As a matter of fact the purity of bottled water is largely a question of commercial honesty. But as has already been indicated, the clearness of water, while perhaps stimulating to the taste, is not synonymous with purity. It follows that the bottled water, honestly collected from a ground water of known purity, naturally tends to be pure and this purity is further assured through storage. It also follows that polluted water may appear in bottles and that the clarity of such water is no proof of its purity.

Household Filters. It is not uncommon to see advertised or in operation in households a small filter which, it is either implied or expressed, is designed to make the water bacteria-free or, in any event, pure and safe. As a matter of fact bacteria readily pass through the finest mesh of cloth or metal. A cheesecloth or screen affixed to a faucet will have no effect on the bacteria, but will only remove gross particles. It is true that such particles offend the eye, but the real pollution in water is the invisible bacteria which cannot be removed by screening. Under appropriate conditions a proper filter may remove some pathogenic bacteria, but the adjustment of such filters is the business of an expert. Even if such a filter is originally effective against pathogenic bacteria, it certainly is not to be depended upon for constant use without the expert adjustment and testing which it practically never receives. Actually the cleaning of such filters by servants without any scientific knowledge is usually

accompanied by the gross contamination of the water. The use of the ordinary household filter is, in general terms, of no value in insuring the purity of water.

Ice. Few instances of ice as a carrier of infection are on record, for, as a rule, bacteria live only a short time in ice. Typhoid fever is apparently rarely transmitted by ice, but some of the milder infections of the intestines, especially in the Tropics, are probably traceable to ice. Ice may be contaminated either from polluted water or in handling. Reasonable care should be taken in the avoidance of polluted water as a source of ice, whether obtained naturally or artificially, and ice should be handled carefully. It should always be remembered that a water supply may be polluted in the process of ice-cutting. It is customary and desirable, therefore, not to utilize water supplies for ice production, unless there is to be subsequent purification of the water.

Swimming Pools. The rapid and desirable increase of favor with which swimming is regarded has presented a new and difficult problem of sanitation. Frequent changing of the water in swimming pools is usually impossible on account of expense, and the constant use of the water is almost certain to cause pollution. A considerable number of infections of the eyes, ears, nose, and throat, a few skin infections, and an occasional internal infection, including typhoid fever, have been traced to the use of a polluted swimming pool.

The sanitation of swimming pools divides itself into two parts, both equally important. In the first place, the individual bather must exercise personal sanitation. Obviously no person with a communicable disease can be allowed in a pool. Before entering the water, the bather must have a cleansing bath with soap, preferably in a near-by shower bath; the swimming pool must not be used for purposes of cleanliness. As few clothes

as possible, preferably none, should be worn in the pool, and the bathing suits should be carefully sterilized. Without reasonable observance of the rules of personal sanitation on the part of the bathers no swimming pool is safe.

Even with the most scrupulous care on the part of the bathers, some contamination of the water is inevitable. The ideal water for a swimming pool is one which is suitable for drinking. This ideal can be maintained at one point, in any event, — at the inlet into the pool. To approach this standard after use by bathers the water must be treated. The water may be purified by the use of ozone or the violet ray but this is too expensive. The use of "bleaching powder" and chlorin is effective, but when they are employed in sufficient amounts to be effective rapidly, these substances are very objectionable on account of the disagreeable odor and the irritating effects on the eyes, nose, and throat. Copper sulphate in sufficient amounts — the amount depends on the composition of the water, the amount of water, the number of bathers, and the frequency of change of water — is apparently very successful in destroying pathogenic bacteria in swimming pools. The combined use of alum as a coagulant, copper sulphate as a disinfectant, and refiltration has been shown to be both effective and economical. The particular method or combination of methods employed depends upon the special conditions.

In any event a swimming pool to be sanitary requires the exercise of personal sanitation on the part of the bathers; the use of water originally suitable for drinking, the frequent periodic examination of the water and, based on this, the use of one or more methods of water purification.

CHAPTER XXI

Sewage

The proper disposal of sewage involves two considerations, — the avoidance of the spread of disease and the avoidance of a nuisance. Formerly it was considered that sewage which constituted a nuisance was a menace to health, but we now know that objectionable as sewer gas and the offensive odors of sewage are, the real danger lies in the bacteria and in their entrance to the human body. With the rather recent use of water to transport sewage, sewage has become less of a nuisance, but more of a danger.

The usual methods of the disposal of fecal matter are three: on the ground, into the ground, or into water. The careless disposal of fecal matter on the ground is always a possible source of danger, whether occasionally in the woods, from Pullman cars — perhaps the day will come when the true significance of this procedure as regards health will be appreciated — or as a practice. In the South the habitual deposit of fecal matter on the ground is the underlying and preventable cause of the ravages of hookworm disease. The old-fashioned open privy, unscreened from flies, is essentially similar to and subject to the same condemnation as the casual disposal of fecal matter on the ground. The use of such privies constitutes both a nuisance and a danger.

The experience of camp sanitation, especially in the European War, indicates that sanitary privies of one

sort or another are both feasible and economical on a large scale. The privy must be protected from the flies which may carry fecal particles with bacteria a considerable distance. The disposal of the fecal material may be into dry earth at some distance from the water supply, or it may be burnt in specially designed incinerators, or disinfected by steam or chemicals. The odors can be avoided by the use of dry earth or other odor-absorbing substances. This method, rather unduly neglected, is particularly suitable for camps, isolated dwellings, summer cottages, and the like. If the fecal material is received into water-tight pails, with a proper amount of earth or similar substance and protected against flies, and then frequently, preferably daily, disposed of *into* the ground or treated with disinfectants, or burned, neither nuisance nor danger results.

Sewers were originally constructed to drain waste water and not to transport fecal material, but with the development of the water carriage system of sewage disposal, the problem became more complicated. The cesspool represents the attempt of the individual or a collection of individuals to dispose of water-carried fecal material. The danger from a cesspool depends primarily on the proximity of the water supply and the character of the soil. Generally the use of cesspools follows the installation of a public water system which will supply adequate water to transport the sewage to the cesspool. In any event the cesspool should mean the abandonment of any near-by wells. In any considerable collection of houses with cesspools, pollution of near-by wells and springs is probable, not only through the soil, but mainly from the overflowing of the overburdened cesspools. Such cesspools, suitably located, by means of proper supervision, including screening and occasional emptying, can be rendered both safe and inoffensive. For the small community

it is often safer as well as more economical to continue the use of cesspools than to build an elaborate sewage system which may be very expensive to construct and to operate satisfactorily and safely.

The advent of water-carried sewage has not solved the sewage disposal problem as bitter experience has taught us. Chicago ran its sewage into Lake Michigan and had an epidemic of typhoid fever from the pollution of her water supply from the same source. Sewage discharged into rivers may, and often does, pollute the water supply of the towns further down. Pathogenic bacteria may be carried many miles in flowing water and the discharges of a single individual may, after polluting a water supply, cause an almost incredibly large epidemic. Sewage disposal into the ocean has in the past polluted shell-fish, particularly oysters, and thus caused typhoid fever. Moreover, the disposal of sewage is always attended by the possibility of constituting a public nuisance. As a result of all these difficulties some control of sewage disposal is necessary. By regulation it is possible to prevent oyster fattening and bathing in polluted waters and to dispose of sewage in such a way and at such times as not to constitute a nuisance. But perhaps in most instances sewage demands some sort of treatment for one or both of the reasons given above, — the avoidance of danger or the avoidance of nuisance.

The treatment of sewage is a problem of sanitary engineering in which great advances have been made in twenty-five years. There are now many devices and methods, all designed to remove bacteria from the sewage, but, ordinarily, no method completely removes all the bacteria. For example, ten to fifteen per cent of the bacteria are removed by the screening out of suspended material. Sixty to seventy per cent are removed by settling tanks or septic tanks. Chemi-

cal precipitation will remove from seventy-five to ninety-nine per cent of the bacteria. The most effective procedure is the broad irrigation method in which the sewage is discharged upon a considerable area of land suitably arranged. The treatment of sewage in any given instance varies widely. In some cases the cost will be the determining factor of the method employed, but, in general, sewage must be treated in some way to eliminate a public nuisance and to minimize the danger to public health.

There are certain obvious questions which arise in the question of sewage disposal. Why is it necessary to treat the water supply and also the sewage? Why not one or the other? Why should a community downstream be obliged to undertake an elaborate engineering project to purify water polluted by the sewers of communities further upstream? The answer to these questions is founded on experience. In the first place surface water of rivers is almost inevitably polluted even without the discharge of sewers into the river. Further, the additional pollution by sewage, if untreated, will overburden and perhaps render ineffective the most expensive and elaborate water purification plant. Then, gross pollution is a public nuisance. As a result of these considerations, it is obvious that there should be coöperation in sanitation between communities. The treatment of sewage does not render the purification of water unnecessary, and vice versa. But, as Hazen has pointed out, of the two the purification of water is the more effective in the saving of lives and the more economical.

Refuse and Garbage Disposal

The problem of refuse and garbage disposal mainly concerns good-sized communities and it is only indi-

rectly related to health. Garbage attracts flies; ashes and street sweepings irritate the nose and throat and favor infection, but the important consideration in this question is the avoidance of a nuisance.

The amount of garbage and refuse in a large city is enormous. In New York City, for example, it has been estimated at a ton per capita per year. In general, there are two methods of the disposal of refuse and garbage, the mixed system and the separate system. In the mixed system, which is commonly used in Europe, all the collected garbage is burnt in specially constructed incinerators, the material being self-consuming. The end products are ashes, used for filling in land, and steam excess, which may be sold. In the separate system, commonly used in the United States, the ashes are used for filling in land, the rubbish is carried to the so-called " dump," and the garbage may be fed to hogs, usually by contract, dumped into the sea or buried, or it is treated at a reduction plant. The end products of a reduction plant are grease, which is sold for the manufacture of soap, and so-called "tankage " (solid particles of cooked garbage), which is used as a filler for fertilizer.

Under proper conditions both incineration and reduction plants can be operated without offensive odors. Under any system of refuse disposal, the essential consideration is the prompt collection of the refuse. If the mixed system of disposal is used, it is relatively simple to insure prompt collection and this is attended with less nuisance.

CHAPTER XXII

Occupational Diseases

While it has long been appreciated that certain trades were hazardous and that certain diseases were connected with certain occupations, it is only within a few years that society has taken an intelligent interest in such conditions. The attitude of employers and of society as a whole has been that the worker must assume all risks as part of the job. In fact, employers have been and are, unless compelled by legislation, almost entirely unwilling to recognize any liability on their part for the health of their workers. This has been especially true if the change of conditions to improve the health of employes necessitated the expenditure of any money. But throughout the world there has developed a movement to compel the employer to recognize that the employes have rights to life and limb, and health as well, so that we now find employers' liability laws in most countries and in most of our own states which are at all advanced in protecting the welfare of their citizens. This movement has been steadily fought by the employers, but we now find that society fairly generally recognizes that the employer has a liability for accident and disease connected with employment. As in most movements connected with the community assuming a somewhat paternal attitude toward the individual citizens, the United States has lagged far behind other countries in its attitude toward industrial hygiene, and, as a

result, we find that there is little definite information on the subject of diseases of occupation or industry in this country.

The following brief classification of industrial diseases, suggested by the United States Public Health Service, gives some idea of the extent and prevalence of such diseases:

a. Workers in harmful substances: Metals, dusts, gases, vapors, and fumes.

b. Workers under harmful conditions: Heat, moisture, cold, confined air (all bad ventilation), overcrowding, compressed air, excessive light, strains of muscles, nerves, or special senses, and the like.

Industrial Accidents. Occupation affects the health most obviously when it exposes the worker to physical accidents. Certain trades, as war, aeroplaning, and the handling of high explosives, are inherently dangerous, but others are dangerous only because proper precautions are omitted. In the metal trades, for example, there has always been a large number of accidents caused by pieces of metal getting into the eyes of the workers. The general attitude of employers towards the health of the employes was well illustrated here. In certain operations it was important in the progress of manufacture that the metal should be kept dry and clean. This was done effectively, but no effort was made to prevent the injury to the employe. Another dangerous trade, a few years ago, was the machine laundry. Women were continually injuring their hands in the mangling machine and seriously crippling their arms and their ability to gain a livelihood. The community was thus forced to support a crippled woman and, sometimes, her family, while the employer merely hired another worker. One immediate result of the usual employers' liability law is that the employers supply their machines

with guards and the crippling of the workers has decreased markedly.

In many mines, even to-day, the omission of safety devices and of reasonable precautions for the safety of the workers displays a brutal disregard of human life and suffering. It is a common fallacy that the dangerous trades are well paid, but, with few exceptions, the exact contrary is true. In actual practice the skilled, intelligent worker naturally shuns the dangerous features of his work. He can get another job. In consequence the dangerous jobs fall to the ignorant and unskilled, who are, in practice, if not in theory, compelled to undertake the dangerous tasks at very little pay. This situation is one of the justifications of the existence of stringent liability laws: While occasional accidents are apparently inevitable in many trades, it has been found that, in a general way, it is possible to avoid most of the accidents of industry. It is often merely a matter of equipping dangerous machines with guards or changing the details of manufacture.

The important relation of work to fatigue has already been indicated. Briefly stated, most accidents happen at the close of a working day or of a working period. With fatigue the alert vigilance is relaxed and the accident happens as a result of the worker's so-called "carelessness." Reasonable hours of labor tend to prevent industrial accidents. While fatigue, strain, and overwork are hardly industrial diseases, they are questions of industrial hygiene in which the community is vitally concerned. The determining factor here is the amount of strain which the worker has to undergo. Hard and fast rules as to the amount of strain and fatigue in any occupation cannot be laid down. It is generally agreed that, at least for women, eight hours is a sufficiently long working day. In the

average occupation, especially where it is associated with machinery, the eight hour day is sufficiently long for any individual. Longer hours mean poorer work, more accidents, and the fatigue which keeps the worker at all times at a low plane of effectiveness and health. The hours of labor should, in the interests of the community as well as of the workers, be regulated by law and controlled by an active and real inspection of the workshop.

Special Occupational Strains. Certain occupations are associated with special strains. The strain on the eyes may be tremendous and in such cases the eye strain may be correctly called an occupational disease. Writer's cramp is an occupational disease which is not so common now as formerly. This condition simply evidences an overwork of the nerves of the arm due to steady writing. Recovery is extremely slow. It is remarkable and illustrative of the highly specialized injury that sufferers from this affliction can usually do everything else save write. Barbers suffer from "barber's palsy" so that they cannot work without great pain.

Waiters are especially subject to flat feet caused by standing for long periods of time, a condition probably aggravated by poor boots. Flat feet are by no means limited to waiters, for the condition is common in all walks of life. The cure and prevention is exercise of the feet to strengthen the muscles. Plates should be resorted to only when compulsory.

Children get into poor habits of posture at school. Improperly arranged and adjusted chairs and desks are the cause of many of the defects of posture and of many of the troubles of the back. When the faulty posture arises from a habit acquired at school or at work, the associated difficulties may rightly be called occupational. We are just beginning to realize how

many people readily acquire faulty habits of posture and of walking. To a considerable extent, varying in different individuals, Nature compensates for this strain, but such bad habits are always potential causes of suffering. Most habits of posture and walking are acquired in childhood, and it is obviously desirable that good rather than bad habits should be acquired. The most suitable place for this would seem to be the school where proper posture and proper carriage should be taught and insisted upon. Suitable exercises to develop proper posture are important, for, wherever possible, the child's own muscles should be developed so as to hold him correctly. Artificial supports and braces are, unfortunately, necessary in occasional instances, but should only be worn under expert advice as their use frequently retards the natural symmetrical development.

Hygienic Environment of Occupation. Many of the ordinary diseases may be associated with occupations and acquired in a particular occupation, although not peculiar to it. The environment of the occupation, however, constitutes one-third of the total environment of the individual. So the condition of the workshop, for example, is of great importance. If the shop is overcrowded, poorly ventilated, dirty, and ill-lighted, there will be more or less disease associated with that shop. Sanitary surroundings, as many employers have discovered, mean better health for the workers and better and more work for the employer. But until stringent factory laws are enforced in all the states, we shall probably have a large number of unsanitary working places. The most notorious of these are the " sweat shops " and, until they are eradicated, the workers in them will be severely affected by the air-borne and contact diseases. Furthermore, in such shops fatigue increases with a resultant lowered re-

sistance to all diseases. Then if a disease is contracted, the result is apt to be fatal on account of the lowered resistance.

Unhygienic working conditions bring about the same illnesses as unhygienic conditions elsewhere. The high incidence of tuberculosis among garment workers in the cities is attributable, not to the occupation, but to the unhygienic conditions. The inadequate washing facilities, the dangerous common towel and drinking cup are frequently the cause of the spread of infection among industrial workers. The community should realize that such shops are foci for disease and that the health of the entire community may be affected through the existence of conditions which at first seem to apply to the employes alone.

Hygienic Conditions in Special Trades. Workers who are compelled to labor under conditions of extreme heat are subject to diseases caused by this exposure to unnatural conditions. It is impossible for men to stand high temperatures for any length of time without prostration. This is illustrated in the case of stokers on steamships. Under the conditions of work, we get heat prostration and heat insanity, followed many times by death. The same conditions prevail in other forms of industry, but the workers are not usually compelled to undergo exposure for any great length of time. Workers who are continually exposed to cold are particularly liable to infections. Dry air and damp air are common conditions in certain industries, and the people who work under such conditions are liable to bronchial trouble. Some of these conditions are difficult or impossible to remedy, but, as far as possible, conditions should be normal as to temperature and humidity. Further, exposure to abnormal conditions of temperature and humidity should be as brief as possible.

Certain trades are known as the "dusty trades." In quarries, for example, the men work under conditions of extreme dust. In all the dusty trades tuberculosis is common among the workers, as well as bronchitis, asthma, and other diseases of the respiratory tract, especially if the trade is combined with indoor work. The irritation of the lungs and bronchi by the fine dust particles predisposes to infection. Adequate devices for the protection of the worker are available. By preference the dust should be removed as is always done when necessary for the product. Failing this, the worker should be supplied with and compelled to wear a mask which does not allow the particles to penetrate.

Caisson disease afflicts workers who labor under the high air pressure necessitated in digging tunnels, for instance. Under such conditions a certain number of workers will have caisson disease, a few will die, and a few will be injured permanently. While working, the men are not bothered, but only when they leave the work and return to the outside air. A system of locks with varying pressures of air now decreases the danger. It is only recently that employers have used such devices, but now that they are liable in case of accidents and disease, they are extremely careful to see that all precautions are taken when the men enter and leave the places of high air pressure.

In certain industries where workers are exposed to chemicals, they are subject to a dermatitis or irritation of the skin. In other occupations there is liability to abrasions of the skin which make infection frequent. Two infections — anthrax and glanders — are closely associated with occupations. Glanders is a disease of horses, which may easily be communicated to the men who handle the animals. The disease in man is rather serious and frequently results in death. Anthrax is essentially a disease of cattle and the anthrax spores

may be carried on the hides and thus gain access to man. The anthrax (or malignant) pustule of man is always serious and is not infrequently a fatal affliction.

Poisoning by fumes is associated with certain industries. Fumes may act merely locally or they may become a general poison. Chlorin gas, for example, acts almost entirely in a mechanical way. The gas gets into the lungs and causes irritation and swelling so that actual strangulation may take place. There are also a number of irritating gases in the manufacture of chemicals. Benzol, for instance, is highly irritating and it also affects profoundly the blood of the people who breathe it.

Lead Poisoning. The most important and best known of industrial poisons is lead poisoning, an industrial disease which has been known since the time of the early Greeks. There are over 150 industries in which the workers are subject to lead poisoning, the most important being painting and the preparation of paint. Potting, enameling, caulking, soldering, and the rubber industries also present a chance of lead poisoning. The greatest danger lies in the preparation of lead.

Lead gets into the system in three ways. The first is by the inhalation of dust or fumes. Men who scrape paint free a large amount of dust which is loaded with lead and the worker inhales it. The inhalation of lead fumes is more important. The second way in which lead poisoning is caused is by ingestion. Artists are apt to modify the point of their brush by putting the point into their mouths. Raphael, Michael Angelo, and Correggio all suffered from lead poisoning. House painters are usually careless in their habits and always seem to have more or less paint on them. Paint may get on their hands and thence into their mouths and systems. Lead may be absorbed through the skin,

but this method of poisoning plays but a slight part in the disease. Individuals vary enormously in their susceptibility to lead poisoning and so the individual equation is an important factor. One person will be poisoned by an amount of lead which will not affect another person in any way.

There are four general symptoms of lead poisoning. The first and most important is the anemia from lead poisoning. In many cases this anemia is the only symptom. The second symptom is the effect on the nervous system. There is a definite paralysis, called lead palsy, which is apt to affect the wrists. This paralysis may be temporary or permanent. In the acute cases of lead poisoning a true case of lead insanity may appear. The third symptom of lead poisoning is "lead cramp" in the gastro-intestinal tract. The patient suffers from acute abdominal cramps. Finally, the fourth symptom is arterio-sclerosis.

For every case of severe lead poisoning there are many mild cases. In England, where an attempt has been made to report the cases, it has been found that in certain trades the incidence of the disease is as high as twenty to thirty per cent. Besides the use of other materials wherever possible and the disuse of lead, precautions should be taken to prevent lead poisoning wherever the material is used. In the case of painters the prevention of lead poisoning is simple. Experiments with a large group of painters have proved that if they follow the precautions laid down, none of the workers will contract lead poisoning. One method of prevention is to wear gloves, but this the men dislike to do. The second precaution is to compel them to get the paint off their hands. Most of the old-time painters go along in the same old way and retain their careless habits and their lead poisoning.

In the preparation of lead and in exposure to the

very dangerous lead fumes, the use of respirators is necessary. The men do not like to use them, but wherever the law makes the employer liable, the respirators are generally worn. It is highly desirable that whereever possible other substances should be substituted for the dangerous lead. Zinc paints are harmless in preparation and in application, and have been used successfully in many places. The painters, however, do not easily accustom themselves to zinc paints, but lead poisoning from paint is so common that any harmless substitute is well worth a trial despite any temporary inconvenience.

Lead poisoning is practically unnecessary. The prevention means simply factory and personal hygiene. A careful worker may be subjected to conditions involving unavoidable risks, but a careless worker may be poisoned under the best of conditions. The experience of stringent legislation in Europe and England indicates, however, that uniform state sanitary laws for the control of the lead trades would largely abolish lead poisoning in the United States.

Occupational Diseases Due to Other Poisons. Until very recently poisoning with phosphorus was prevalent. This was caused during the manufacture of the so-called "phosphorus match." Phosphorus poisoning was accompanied by a deforming disease of the jaw — the "phossy jaw." For a long time it was known that a particular preparation of phosphorus could be used which was not at all poisonous and which made a match which could be lighted anywhere. But this form of phosphorus was slightly more expensive and the manufacturers refused to use it. Finally a law was passed forbidding the use of poisonous phosphorus, and now phosphorus poisoning has practically disappeared from the United States and most European countries.

Carbon bisulphide is used to a certain extent in the rendering process to dissolve certain fats. This gas has been recognized as extremely poisonous and in most countries its use has been forbidden. Carbon bisulphide is a deadly poison and produces nervous diseases which may lead to insanity and death.

Nitro-benzol is a dangerous substance used in the manufacture of high explosives. Workers with this substance, who do not wear respirators, are almost certain to contract extreme nervous disorders.

Arsenic was formerly used to a large extent in the coloring of wall paper, artificial flowers, toys, and the like, and epidemics of arsenic poisoning resulted. This use of arsenic has almost disappeared.

Mercury is used in the manufacture of mirrors and thermometers and may cause acute poisoning. Chronic mercury poisoning produces a condition which is known as the "trembles." This form of poisoning may be avoided by the use of the same precautions as for lead. Wood alcohol, antimony, brass, and copper all cause a certain amount of poisoning.

Conclusions. We know relatively little about the extent of these occupational diseases, but as communities learn to realize their importance to society we shall doubtless learn more and, perhaps, eliminate many of them. In considering the occupational or industrial diseases many factors have to be weighed. The general factors of work have to be examined, and, furthermore, if a man works in a shop eight hours, conditions during the other sixteen hours must be understood.

The general proposition that the voluntary contract between employer and worker relieves the employer of responsibility in regard to accident or disease contracted in his work has been definitely settled in the negative. The community is slowly interfering in these voluntary contracts, for, the community argues,

in the long run it is society that suffers when the worker is injured or diseased. In the most obvious instance the community has to support a crippled worker and his family. Consequently every year sees upon the statute books a new accumulation of labor legislation, legislation, in the main, restrictive. The hours of labor for women and children and on public work are becoming universally restricted, and the tendency is towards a general restriction of the hours of labor. Then there are numerous laws which compel the use of various safety appliances. Further, we have a wide variety of legislation compelling factory inspection with the view of securing adequate hygienic conditions in the workshop. Efficient factory inspection is the vital part of the program for the prevention of occupational diseases and the development of industrial hygiene.

The various employers' liability laws, in point of fact, only fix penalties. In some ways the legislation, as in the case of accidents and lead-poisoning, lags behind the available knowledge. In others there is still a great lack of definite information upon which to base an intelligent legislative program. The records of an industrial accident board show a mass of conflicting expert testimony. In such records the principle is being established that lead poisoning, for example, is an accident attributable to the industry, just as the loss of a hand in a mangle. But what is to be said of arterio-sclerosis, kidney disease, and other lesions, which are very common among the workers in lead? At present the information is generally too inadequate to establish a causative relationship in any given case. Likewise in a number of industries, for example, those associated with metals, with fumes, and with high electric currents, peculiar illnesses are not uncommon, concerning which, at the present time, definite knowledge

is lacking. Undoubtedly we are only on the threshold of knowledge concerning industrial diseases. We must have an intensive study of many occupations and careful collection and statistical tabulation of all the facts. Such studies are reasonably common in Europe, but, so far, the United States has lagged behind.

CHAPTER XXIII

The Function of the Board of Health

Boards of health, departments of health, or commissioners of health have gradually developed with the necessary delegation of the specialized activities of the community to one person or to a group of persons. The presumption is that such officials bring special skill or knowledge to the administration of the particular department of the community's affairs. Under various titles and schemes of organization boards of health have been in existence for a long time, but the activity of such boards has varied widely. Forty or more years ago, when little was known about disease, boards of health were largely concerned with the prevention of nuisances. The smoke nuisance, cesspools, the carting of garbage, the keeping of pigs and other animals were supposed to be the functions of such boards. We now know that nuisances are not necessarily menaces to health, and, while boards of health may be given the control over them, it is hardly an important function.

The control of epidemics has been fairly universally delegated to boards of health, together with quite extraordinary powers. These powers, however, were given with such epidemics as smallpox in mind. Where only a few diseases were formerly supposed to be communicable, the present list of known communicable diseases is long. So, whatever the authority to control epidemics, public opinion is not ready to countenance

the exercise of such authority in other diseases, as it is in the case of smallpox, leprosy, or infantile paralysis.

Unfortunately the general public has no clear idea as to the functions or the scope of health boards. In addition the public is convinced that boards of health are the proper prosecuting agency in the adulteration of milk or foods, or in the substitution of oleomargarine for butter. Adulteration of foods and misbranding are not essentially matters of health, but, in reality, concern the police department, like any attempt to obtain money under false pretences. Then, too, the confusion in the minds of the public concerning boards of health is sometimes reflected in the caliber of the men appointed or elected. In Massachusetts it required legislation to compel cities and towns, in which the selectmen did not act as the board of health, to have a medical man on the boards. Moreover, boards of health are handicapped by insufficient appropriations, for many unhygienic conditions require inspections before they can be detected and corrected. The United States government sets a rather poor example, although some progress is being made. But our national government still devotes more attention and more money to the statistics of hogs and corn and their diseases, and their correction and prevention, than to similar statistics and measures for its citizens.

In spite of lack of funds, public indifference, and other handicaps, boards of health and health officials have accomplished much good. The studies of the Massachusetts State Board of Health, which date back many years, are notable contributions to sanitary science. The United States Public Health Service has many important achievements to its credit; the work against plague in California is one among many. But in general, boards of health unsupported

by public opinion, hampered by insufficient funds, and handicapped by politics, have not been effective in small communities and only moderately so in large communities. Unquestionably the greatest handicap has been the lack of an intelligent public opinion. Within forty years the new preventive medicine has appeared and has developed rapidly. Each new discovery has meant the discarding of an old policy or an old regulation of the board of health. But what is more important is that the public has not as yet assimilated a reasonable amount of this new knowledge and has not yet been able to visualize at all clearly the scope and functions of a present-day board of health.

The department of health in a community should be the official authority on health for that community. Obviously its personnel should have special knowledge or skill in the matter of health and should concern themselves with everything that involves the health of the individual or the community. An effective board of health must undertake the following functions, which may be classified as follows.

Vital Statistics. This is merely the bookkeeping of health. Such statistics include not only statistics of births and deaths, but also accurate records of cases of disease. They must include the incidence of all communicable diseases and of any other disease concerning which information is desirable, such as occupational diseases, pellagra, and the like.

Sanitary Engineering. The function of the purification of the water supply and the disposal of sewage belongs to the board of health. This is gradually becoming more and more a community problem, for, as has been shown, the relation of water and sewage to health is close.

Control of Communicable Diseases. This is, perhaps, the most important function of the health board.

The control of communicable diseases means investigation of each case of communicable disease and the removal, if possible, of the cause as well as the prevention of the spread of the disease from any individual case. The actual measures of quarantine, isolation, and disinfection vary with each disease and the community should hold the health board responsible for the efficiency of all such measures. The problem of the communicable diseases is so large that often the control of tuberculosis is regarded as a separate function.

Laboratory. Early diagnosis of communicable disease is essential to its prevention. The community is the gainer by furnishing opportunity for such examinations, which, in many instances, are beyond the power of the busy practitioner. Such examinations include those of the sputum for tubercle bacilli, the examination of cultures from the throat for diphtheria, the examination of the blood for the reaction of syphilis or of typhoid fever, the examination of stools for typhoid bacilli, and the like. As a part of the laboratory function may well come the supervision or actual supply of such biological products as smallpox vaccine, anti-typhoid vaccine, and diphtheria antitoxin. The State Board of Health in Massachusetts wisely argued years ago that if the state law compelled vaccination for the protection of health, it was the manifest duty of the state board to furnish vaccine of known purity.

Chemical Examination. This includes the examinations of food products and the like, including milk. The examination of milk is of great importance in protecting health. Examinations of other foods may also be of importance, but they are usually devoted to the detection of fraud. While such activity is, perhaps, not essentially a function of the board of health, yet it has apparently become so by general custom.

Education. An extremely important function of boards of health is the proper dissemination of available knowledge concerning disease and its prevention. In some instances the control of disease depends on the personal habits of individuals, and in practically all instances even the most autocratic control requires some coöperation from the individuals of the community. Our present knowledge of health affairs has considerably distanced our application of this knowledge. This application depends on the intelligent coöperation of individuals not only in the actual carrying out of instruction, but also in the creation of a public opinion which alone will support those regulations of the health authorities which may interfere with personal interests.

Industrial Hygiene. The rôle of industries in affecting health is sufficiently important to warrant special study. Such study is essentially a function of the health department.

Infant Mortality. In large communities and in collections of communities, as the state and nation, the control of infant mortality represents a separate function in itself. The prevention of infant mortality, of course, is in a way covered by other functions of the board of health, yet the importance and specialized nature of certain aspects of the problem frequently make separate treatment and special attention desirable.

School Hygiene. The control of the health of school children, the future parents of the race, is extremely important to the community. Every state spends large sums on the education of children who will die of preventable disease before that education can be utilized. It is in youth that sound health habits are best formed. Many communities are recognizing the importance of the health of school children by the

introduction of school nurses, school physicians, and the increased care of the sanitation and hygiene of the schoolroom.

A higher degree of health is obtainable under military discipline than under any other conditions. The health of the Canal Zone is a brilliant illustration of the effectiveness of sanitary regulations under military rule. The health organization of the Canal Zone under Surgeon General Gorgas was able to enforce its regulations. If any community or nation is to approach the sanitary effectiveness of military rule, it is necessary to develop intelligent coöperation between the individual and the community as represented by the health authorities. No separation between community health and personal health is possible. The individual shares in the health or disease of his community, and he has, therefore, his share in the responsibility.

In the long run health (or the prevention of disease) is a purchasable commodity, and it is not, perhaps, cheap. So it is the true function of the health organization to bring it about that the individuals and the community receive the full value of all money expended for health.

CHAPTER XXIV

VITAL STATISTICS

THE collection of vital statistics is a fundamental procedure in the prevention and control of disease. In order to devise and test methods of disease prevention, it is necessary to have records of births and deaths and also a record of the diseases which caused the deaths. The necessity for collecting and preserving such figures has been recognized by almost every nation in the world except the United States. We have in this country a complete record of the number of cattle, sheep, and hogs, and a record of every legal procedure, but the statistics which concern human lives are unavailable. It is true that every ten years we have a census, but such statistics are the only vital statistics which are at all accurate. A number of the states make no pretence of keeping a record of even the births, deaths, and marriages.

At the present time we get a report of the deaths in the "registration area" of the United States. This area includes about two-thirds of the country. Basing our statistics on the results from the registration area we are able to estimate such important things as the number of deaths from typhoid fever, pneumonia, tuberculosis, and other diseases, but, obviously, such estimates are far from accurate.

This matter of vital statistics is done much better in other countries. By the use of their careful statistics, it has been possible to find out what factors conduce

the most to diminish the mortality of disease. In the case of tuberculosis, for instance, it was found out through statistics that the segregation of the advanced cases was the greatest factor in the decrease of the mortality.

It would seem that it should be obvious to every one that we must have vital statistics on births, deaths, and marriages. The possession of a birth certificate may be required in many ways by an individual during his lifetime. After reliable statistics concerning the number of deaths have been secured, it is further necessary to secure the causes of death, and, then, the reporting of the actual cases of disease — morbidity statistics. At the present time, as a result of our lack of health statistics, we have little idea how widespread industrial diseases are. The only way in which we can make progress is to have available in a registration area not only the number of deaths but also the number of cases of lead poisoning, for example. Again, it may be necessary to determine the efficacy of diphtheria antitoxin, but we are absolutely unable to do this unless we have accurate statistics regarding diphtheria.

The reporting of certain diseases is necessary in addition to their value for statistics, for only in this way can we prevent their spread. If smallpox, for example, were able to exist without being reported to the health authorities, it would be perfectly possible for an epidemic of the disease to start up and assume such headway that suppression would be difficult.

When the collection of reports of disease was first begun, there was tremendous opposition, but with the gradual increase of knowledge about communicable diseases, this opposition has died down. Tuberculosis has only recently been placed on the list of diseases to be reported, although an understanding of the

disease indicates how necessary this is. People seem to have a peculiar objection to the reporting of tuberculosis and the disease is not reported so accurately as should be the case. As a result of the attitude of the people, a curious situation existed until very recently in Massachusetts, where more people died from tuberculosis than there were cases reported. Such a situation can only be improved by the education of the people so that they shall appreciate the benefit to the community and to themselves through having tuberculosis reported.

At the present time there is considerable discussion about the reporting of the venereal diseases. The same arguments are used against reporting such diseases that have been used against the reporting of all the other diseases. But people entirely miss the point of the desirability of reporting the venereal diseases. We need statistical evidence of them in the hope that by reporting them something active, something remedial, will come out of the findings. Statistics are entirely impersonal, absolutely oblivious of the individual, and utterly unconcerned with his personal secrets.

Vital statistics have been called the "bookkeeping of humanity." They are necessary for safeguarding our health and, until we can procure additional and accurate statistics, we are badly handicapped in attempting to cope with the diseases which afflict the community.

APPENDIX

Composition of American Foods according to Atwater and Bryant

	Refuse	Water	Protein	Fat	Carbohydrates	Ash	Fuel Value per Pound
Beef, cooked							
Roast		48.2	22.3	28.6		1.3	1620
Round steak . .		63.0	27.6	7.7		1.8	840
Beef, canned							
Corned		51.8	26.3	18.7		4.0	1280
Dried		44.8	39.2	5.4		11.2	960
Tongue . . .		51.3	19.5	23.2		4.0	1340
Veal, breast . . .	24.5	51.3	15.3	8.6		.8	645
Leg	11.7	63.4	18.3	5.8		1.0	585
Lamb, cooked							
Chops	13.5	40.1	18.4	26.7		1.2	1470
Leg, roast . . .		67.1	19.7	12.7		.8	900
Mutton, cooked							
Leg, roast . . .		50.9	25.0	22.6		1.2	1420
Pork, fresh							
Chops	19.3	40.8	13.2	26.0		.8	1340
Ham	12.2	35.8	14.5	33.2		4.2	1670
Bacon	8.7	18.4	9.5	59.4		4.5	2685
Sausage . . .		39.8	13.0	44.2	1.1	2.2	2125
Poultry, cooked							
Chicken, fricassee		67.5	17.6	11.5	2.4	1.0	855
Turkey, roast		52.0	27.8	18.4		1.2	1295
Fish							
Bass	55.0	35.1	8.4	1.1		.5	200
Cod	29.9	58.5	11.1	.2		.8	215
Mackerel . . .	44.7	40.4	10.2	4.2		.7	365
Salmon . . .	34.9	40.9	15.3	8.9		.9	660
Shad	50.1	35.2	9.4	4.8		.7	380
Trout	48.1	40.4	9.9	1.1		.6	230
Cod, salt . . .	24.9	40.2	19.9	.4		18.5	315
Sardines . . .	5.0	53.6	23.7	12.1		5.3	950
Caviar		38.1	30.0	19.7	7.6	4.6	1530

Composition of American Foods — *Continued*

	Refuse	Water	Protein	Fat	Carbohydrates	Ash	Fuel Value per Pound
Fish — *Continued*							
Crabs	52.4	36.7	7.9	.9	.6	1.5	195
Lobster . . .	61.7	30.7	5.9	.7	.2	.8	140
Oysters . . .	81.4	16.1	1.2	.2	.7	.4	45
Scallops . . .		80.3	14.8	.1	3.4	1.4	345
Eggs, boiled . . .	11.2	65.0	11.7	10.7		.7	680
Butter		11.1	1.0	85.0		3.0	3605
Cheese, American .		31.6	28.8	35.9	.3	3.4	2055
Cream		34.2	25.9	33.7	2.4	3.8	1950
Milk, condensed .		26.9	8.8	8.3	54.1	1.9	1520
Evaporated . .		68.2	9.6	9.3	11.2	1.7	780
Whole		87.0	3.3	4.0	5.0	.7	325
Bread, gluten . .		38.2	9.3	1.4	49.8	1.3	1160
Crackers, butter .		7.2	9.6	10.1	71.6	1.5	1935
Graham . . .		5.4	10.0	9.4	73.8	1.4	1955
Pie, apple . . .		42.5	3.1	9.8	42.8	1.8	1270
Lemon		47.4	3.6	10.1	37.4	1.5	1190
Candy					96.0		1785
Sugar					100.0		1860
Vegetables							
Asparagus, cooked		91.6	2.1	3.3	2.2	.8	220
Cabbage . . .	15.0	77.7	1.4	.2	4.8	.9	125
Celery	20.0	75.6	.9	.1	2.6	.8	70
Corn, green . .	61.0	29.4	1.2	.4	7.7	.3	180
Lettuce . . .	15.0	80.5	1.0	.2	2.5	.8	75
Onions, cooked .		91.2	1.2	1.8	4.9	.9	190
Potatoes . . .	20.0	62.6	1.8	.1	14.7	.8	310
Tomatoes . . .		94.3	.9	.4	3.9	.5	105
Olives	19.0	52.4	1.4	21.0	3.5	2.7	975
Pickles		93.8	1.1	.4	4.0	.7	110
Squash	50.0	44.2	.7	.2	4.5	.4	105
Fruits							
Apples	25.0	63.3	.3	.3	10.8	.3	220
Bananas . . .	35.0	48.9	.8	.4	14.3	.6	300
Grapes . . .	25.0	58.9	1.0	1.2	14.4	.4	335
Oranges . . .	27.0	63.4	.6	.1	8.5	.4	170
Strawberries . .	5.0	85.9	.9	.6	7.0	.6	175
Nuts, edible portion							
Almonds . . .		4.8	21.0	54.9	17.3	2.0	3030
Peanuts . . .		9.2	25.8	38.6	24.4	2.0	2560
Chocolate . . .		5.9	12.9	48.7	30.3	2.2	2860

Composition of American Foods — *Continued*

	Refuse	Water	Protein	Fat	Carbohydrates	Ash	Fuel Value per Pound
Soups, canned							
Bouillon . . .		96.6	2.2	.1	.2	.9	50
Chicken . . .		93.8	3.6	.1	1.5	1.0	100
Pea		86.8	3.6	.7	7.6	1.2	235
Hash		80.3	6.0	1.9	9.4	2.4	365
Breakfast-foods							
Cracked wheat .		10.1	11.1	1.7	75.5	1.6	1685
Shredded wheat .		9.6	12.1	1.8	75.2	1.3	1700
Oatmeal, boiled .		84.5	2.8	.5	11.5	.7	285
Rolled oats . .		7.7	16.7	7.3	66.2	2.1	1850
Rice, boiled . .		72.5	2.8	.1	24.4	.2	510

INDEX

B

I